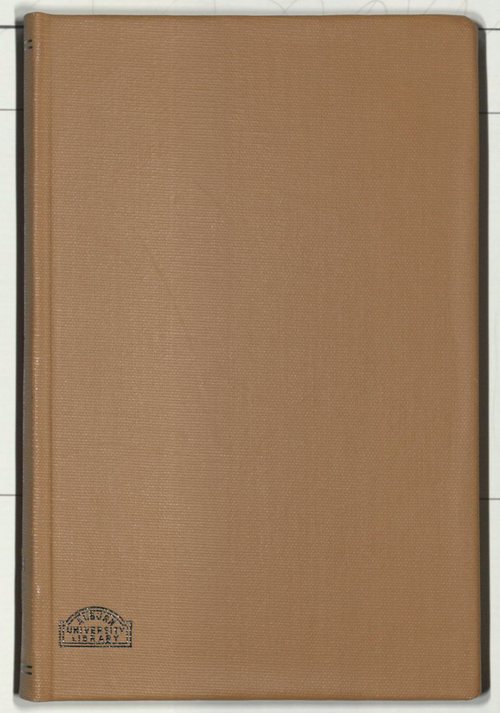
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BIOSTRATIGRAPHIC CORRELATION OF THE TYPE SHUBUTA MEMBER OF THE YAZOO CLAY AND RED BLUFF CLAY WITH THEIR EQUIVALENTS IN SOUTHWESTERN ALABAMA

By Phili B. Deboo

GEOLOGICAL SURVEY OF ALABAMA BULLETIN 80

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Philip E. LaMoreaux
State Geologist

DIVISION OF PALEONTOLOGY,
STRATIGRAPHY, AND GEOPHYSICS

Thomas J. Joiner
Chief Geologist

BULLETIN 80

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By Phili B. Deboo

UNIVERSITY, ALABAMA

1965

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Honorable George C. Wallace
Governor of Alabama
Montgomery, Alabama

Dear Governor Wallace:

I have the honor to transmit herewith a report entitled "Biostratigraphic Correlation of the Type Shubuta Member of the Yazoo Clay and Red Bluff Clay with Their Equivalents in Southwestern Alabama," by Phili B. Deboo, with the request that it be printed as Bulletin 80 of the Geological Survey of Alabama.

This report identifies and illustrates Ostracoda and Foraminifera from the upper Eocene and Oligocene strata of southeastern Mississippi and southwestern Alabama. It is an important contribution to the science of geology, as well as to the geology of the State. The report will aid future surface and subsurface geological interpretations.

Information gained from this study and other coordinate research studies will assist in the greater development of the mineral resources of Alabama.

Respectfully,

Philip E. LaMoreaux

Philip E. LaMoreaux
State Geologist

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BIOSTRATIGRAPHIC CORRELATION OF THE TYPE SHUBUTA MEMBER OF THE YAZOO CLAY AND RED BLUFF CLAY WITH THEIR EQUIVALENTS IN SOUTHWESTERN ALABAMA

By Phili B. Deboo

ABSTRACT

Boundaries between time-stratigraphic units were established principally by paleontologic evidence, that is, at major and minor biostratigraphic discontinuities.

The present study is an attempt to establish a boundary between the Jacksonian and Vicksburgian Stages in eastern Mississippi and western Alabama and to determine its relation to that between the Eocene and Oligocene Series. For this problem occurrence data for three microfossil groups with widely different ecological control, ostracods, planktonic foraminifers, and benthonic foraminifers were analyzed. These data were obtained from samples collected from four continuously exposed sections in southwestern Alabama and one composite section in southeastern Mississippi ranging from the Cocoa Sand Member of the Yazoo Clay (Jacksonian) to the Marianna Limestone (Vicksburgian).

The range data were plotted on charts, and those for ostracods and planktonic foraminifers were analyzed visually. The benthonic foraminiferal fauna, however, is so diversified that a numerical index of comparison of vertically successive samples had to be used. For this purpose, Simpson's coefficient of faunal resemblance was found to be adequate.

The range data for all three groups form the basis of three major biostratigraphic assemblage units, *Floridina antiqua*, *Spondylus dumosus*, and *Lepidocyclina mantelli* zones, and two minor ones, *Cribrohantkenina "danvillensis"* and *"Cythereis" blanpiedi* subzones (of *Spondylus dumosus* zone). Simpson's coefficients for each of the taxonomic groups from one zone to another are lower than for one subzone to another. Moreover, the coefficient of resemblance between the *Spondylus dumosus* zone, and the *Floridina antiqua* zone (Jacksonian) is considerably lower than that between the *Spondylus dumosus* zone and the *Lepidocyclina mantelli* zone (Vicksburgian). For this reason, it seems logical that the Jacksonian-Vicksburgian boundary be placed at the base of the *Spondylus dumosus* zone.

The presence of *Cribrohantkenina inflata*-bearing beds within the *Spondylus dumosus* zone, i.e., in the Vicksburgian, makes it improbable that the Jacksonian-Vicksburgian boundary is coincident with the Eocene-Oligocene boundary as most

Gulf Coast stratigraphers have assumed. Furthermore, inasmuch as the upper Eocene part of the *Spondylus dumosus* zone (the *Cribrohantkenina "danvillensis"* subzone) passes upward through the *"Cythereis" blanpiedi* subzone into the *Lepidocyclina mantelli* zone (considered by some stratigraphers to be lower Miocene) without major discontinuity, the hypothesis that there are no sediments of Oligocene age in the Gulf Coast appears invalid.

Although the microfauna was studied in detail and all important species (58 ostracods and 165 foraminifers) are here illustrated, a complete taxonomic study has not been attempted. Brief nomenclatural notes are included for a few species.

INTRODUCTION

An objective of Gulf Coast stratigraphers for many years has been to establish the boundary between the Jacksonian and Vicksburgian Stages at a consistently recognizable discontinuity. The use of lithology has not been successful, because vertically successive rock types are commonly gradational or, in instances where there is an easily observed lithologic discontinuity, the hiatus is generally minor. Furthermore, the Jacksonian and Vicksburgian deposits change facies laterally from limestones in Florida and southeastern Alabama to marls and clays in southwestern Alabama to sands and clays farther west. The Jacksonian-Vicksburgian boundary, a time-stratigraphic horizon, therefore, has been tenuously defined on the basis of lithology alone. Although many attempts have been made to fix the boundary paleontologically, none has involved the study of the majority of the fauna. A biostratigraphic study of a large section of the total fauna, including megafossils, benthonic foraminifers, planktonic foraminifers, and ostracods, were used in this study to identify and correlate the Jacksonian-Vicksburgian boundary in the critical area of facies change in eastern Mississippi and western Alabama.

The contact between the Jacksonian and Vicksburgian Stages is generally regarded as the Eocene-Oligocene contact in the Gulf Coast. Eames and others (1962), however, after a study of planktonic and larger foraminifers and molluscs, concluded that a period of nondeposition in the Gulf Coastal Plain extended throughout Oligocene time, so that the disconformity between the Jacksonian and the Vicksburgian deposits brings into contact rocks of late Eocene and early Miocene age. Data obtained in the present study, however, indicate the horizon of *Cribrohantkenina "danvillensis"*,

regarded by Eames and others (1962) as late Eocene, lies above the major stratigraphic discontinuity, considered in this report as the Jacksonian-Vicksburgian boundary. The upper boundary of the beds bearing *Cribrohantkenina inflata* is not a major biostratigraphic discontinuity, although it has been so regarded by many Gulf Coast stratigraphers.

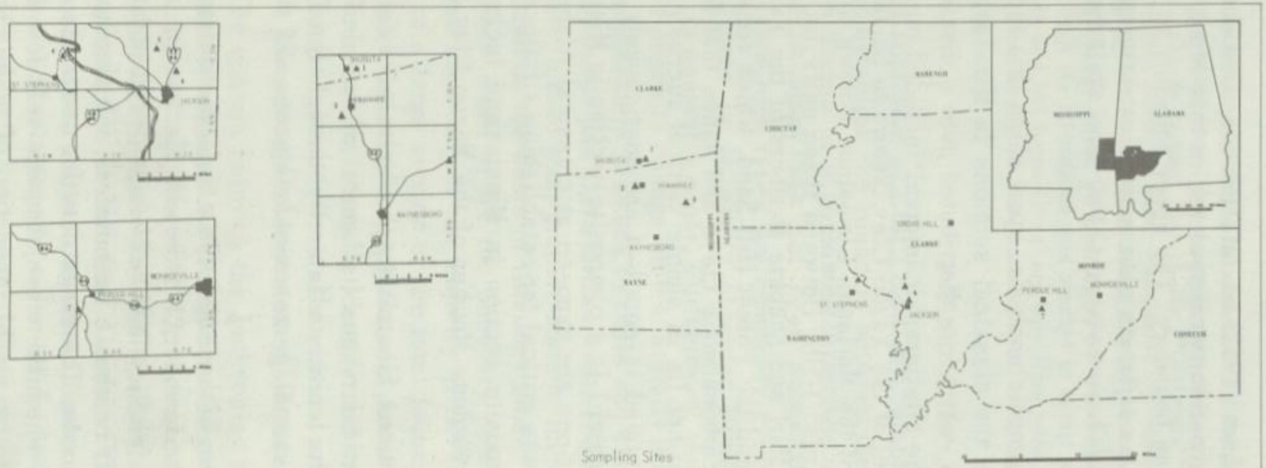
The detailed biostratigraphic analysis, upon which this report is based, is confined to the classical sections in Mississippi and southwestern Alabama, which are distributed over a distance of about 50 miles (fig. 1). The stratigraphic interval[1] included ranges from the Cocoa Sand Member of the Yazoo Clay (known to be Jacksonian) to the lower part of the Marianna Limestone (known to be Vicksburgian) (figs. 2, 3, pls. 1-10). Between these units lie the sediments of the Pachuta Marl and Shubuta Members of the Yazoo Clay, the Red Bluff Clay and the Forest Hill Sand, which consist of marls, calcareous and carbonaceous clays and sands that form a sequence of beds that do not lie in simple vertical succession.

Five sections were studied in detail—4 are continuously exposed sections in Alabama and 1 is a composite section in Mississippi. The continuous sections are exposed at classical Alabama localities, and their study was critical for establishing stratigraphic relationships. The composite section in Mississippi includes the type exposures of the Shubuta Member of the Yazoo Clay and the Red Bluff Clay.

In each of the five sections, biostratigraphic units were established on the basis of vertical ranges (teilzones) of foraminifers and ostracods. These units correlate laterally through the five sections (figs. 10, 11) as assemblage zones or faunizones and their subdivisions.

The contact between two of these units is a major discontinuity regarded in this report as the boundary between the Jacksonian and Vicksburgian Stages. The microfossils have been analyzed in detail as three separate units: (1) benthonic foraminifers, (2) planktonic foraminifers, and (3) ostracods. The range data for ostracods and planktonic foraminifers, of which there are comparatively few species, have been interpreted by visual inspection of range charts

[1] The stratigraphic nomenclature used in this report conforms to the usage of the Geological Survey of Alabama.



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1. Shubuta Hill. In a gully along north side of road in NW¼ sec. 10, T. 10 N., R. 7 W., Clarke County, Mississippi. Formations exposed: Cocoa Sand Member(?), Pachuta Marl Member, and Shubuta Member of the Yazoo Clay.
2. Hiwannee. Bluff on the Chickasawhay River in SW¼ sec. 28, T. 10 N., R. 7 W., Wayne County, Mississippi. Formations exposed: Shubuta Member of the Yazoo Clay and Red Bluff Clay.
3. Road cut on north side of Waynesboro-Silas Highway in SE¼ sec. 13, T. 9 N., R. 6 W., Wayne County, Mississippi. Formations exposed: Forest Hill Sand, Mint Spring Marl Member of the Marianna Limestone and upper limestone member of the Marianna Limestone.
4. St. Stephens Quarry. Sec. 14, T. 7 N., R. 1 W., Washington County, Alabama. Formations exposed: Pachuta Marl Member and Shubuta Member of the Yazoo Clay, Red Bluff Clay, Forest Hill Sand and Marianna Limestone.
5. Little Stave Creek. Sec. 17, T. 7 N., R. 2 E., Clarke County, Alabama. Formations exposed: Cocoa Sand Member(?), Pachuta Marl Member and Shubuta Member of the Yazoo Clay, Red Bluff Clay and Marianna Limestone.
6. Section 1½ miles north of Jackson, Alabama exposed in a gully 200 feet east of highway. Sec. 28, T. 7 N., R. 2 E., Clarke County, Alabama. Formations exposed: Jackson Group undifferentiated, Red Bluff Clay and Marianna Limestone.
7. Perdue Hill Section. 1½ miles south of Perdue Hill, Alabama, SW¼ sec. 7, T. 6 N., R. 6 E., Monroe County, Alabama. Formations exposed: Ocala Limestone, Red Bluff Clay and Marianna Limestone.

Sampling site and reference number ▲ 1

Figure 1.—Area of study and location of sampling sites.

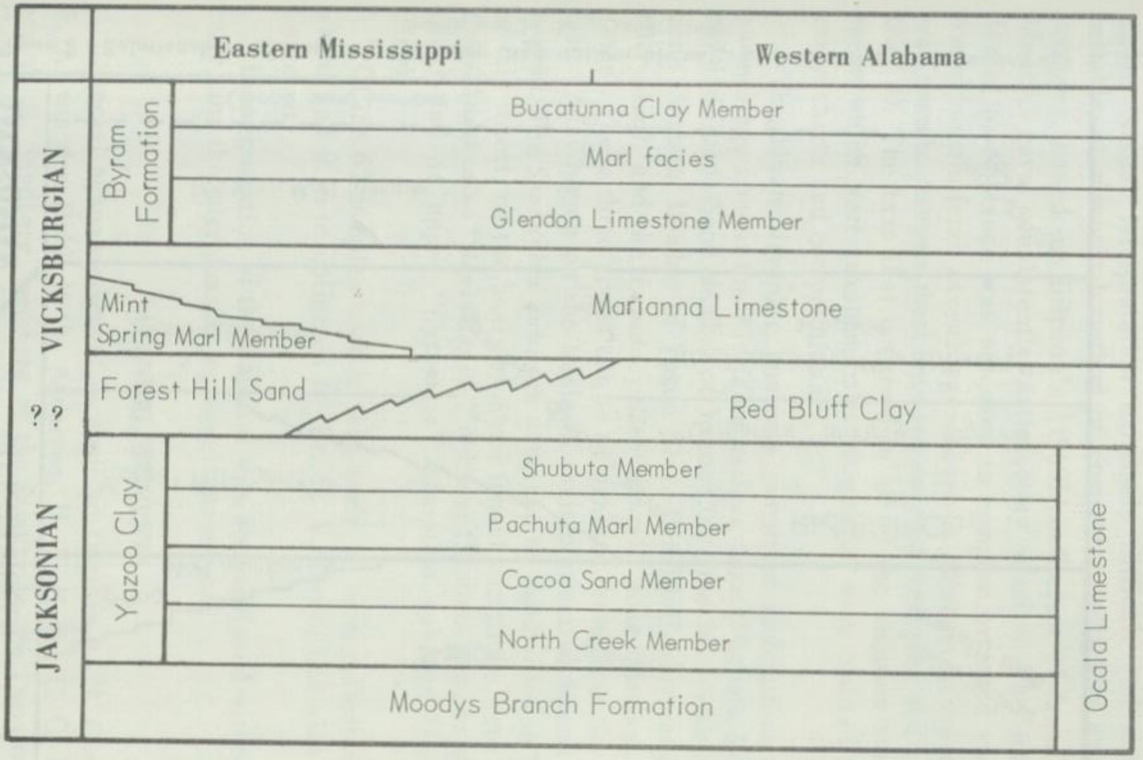

Figure 2.—Generally accepted lithostratigraphic units of Jacksonian-Vicksburgian age in area of study.

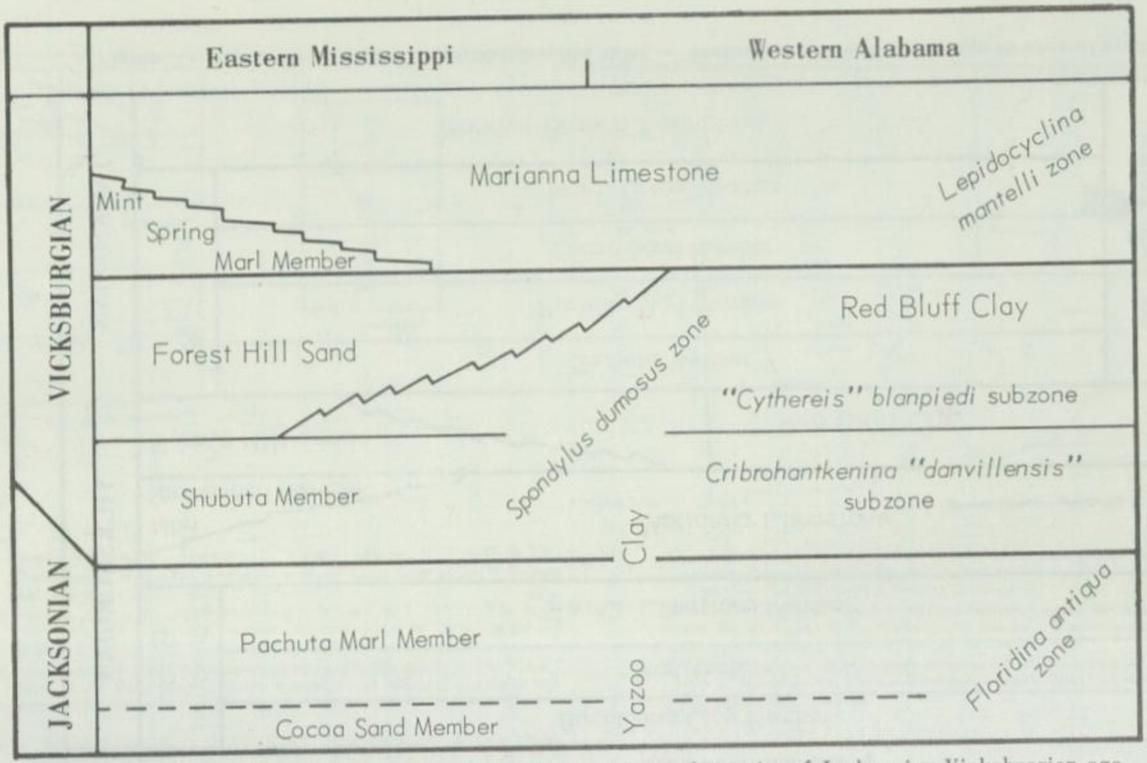

Figure 3.—Relationships of biostratigraphic and lithostratigraphic units of Jacksonian-Vicksburgian age determined in the present study.

(pls. 1-10). The large number of benthonic foraminiferal species makes visual interpretation extremely difficult and much less reliable. A numerical method of comparing vertically successive samples, based on Simpson's (1960) coefficient of faunal resemblance, gave consistently satisfactory results. The method of faunal resemblance was not used to compare ostracod and planktonic foraminiferal assemblages between adjacent samples, but it was used to compare them between successive zones and subzones (fig. 9). The taxa that occurred in all of the samples studied, or those which were taxonomically enigmatic, were omitted from the range charts and computations.

The biostratigraphic analysis permitted recognition of three assemblage zones: the *Floridina antiqua* zone (Pachuta Marl Member and Cocoa Sand Member of Yazoo Clay), the *Spondylus dumosus* zone (Shubuta Member of Yazoo Clay, Red Bluff Clay, and Forest Hill Sand), and the *Lepidocyclina mantelli* zone (Marianna Limestone). These three zones can be recognized throughout the eastern Gulf Coast region on the basis of their distinctive faunal assemblages. The *Spondylus dumosus* zone can be subdivided in the area of this report, on the basis of minor faunal variations, into a lower *Cribrohantkenina "danvillensis"* subzone (Shubuta Member of Yazoo Clay) and an upper *"Cythereis" blanpiedi* subzone (Red Bluff Clay).

Of the 62 samples used in this study, 53 were collected by the writer and 9 were collected by Dr. H. V. Howe, Louisiana State University.

Disaggregation of the material was accomplished without difficulty, and the microfossils were well preserved.

ACKNOWLEDGMENTS

Special acknowledgment is made to Doctors A. H. Cheetham, W. A. van den Bold, H. V. Andersen, H. V. Howe, C. O. Durham and A. E. Sandberg, members of the faculty in the Department of Geology at Louisiana State University, for guidance and assistance during the field studies and preparation of this report.

Acknowledgment is also made to Lewis G. Nichols, Assistant Curator of the Geology Museum at Louisiana State University, who

assisted in collecting some of the samples used and prepared photomicrographs.

Charles W. Copeland, paleontologist, Geological Survey of Alabama, supervised the preparation of the range charts and reviewed the manuscript.

This report is published as a result of the Geological Survey of Alabama program of graduate research in cooperation with universities and colleges throughout the country.

BIOSTRATIGRAPHY

GENERAL CONSIDERATIONS

The establishment of the boundary of the Jacksonian-Vicksburgian Stages has been recognized as principally a paleontologic problem (Murray and Wilbert, 1950). Skeletal materials, such as tests of foraminifers, carapaces of ostracods, and hard parts of other marine organisms abound in upper Jacksonian and lower Vicksburgian sediments, at least eastward from Mississippi. Megafossils (molluscs, echinoids, and other fossils) have been extensively used because they are easily identifiable in the field and generally give an idea of stratigraphic position. Their occurrences, however, are too sporadic to establish a precise boundary between biostratigraphic units correlatable over a large region, such as the central and eastern Gulf Coast. Some of the more common species that have been used for identifying biostratigraphic units and their stratigraphic occurrences are:

Actinocyclina bainbridgensis Vaughan (Pachuta Marl Member and Cocoa Sand Member of Yazoo Clay)

Chlamys spillmani (Gabb) (Pachuta Marl Member and Cocoa Sand Member of Yazoo Clay)

Clypeaster rogersi (Morton) (Marianna Limestone)

Cyclaster drewryensis Cooke (Red Bluff Clay)

Lepidocyclina mantelli (Morton) (Marianna Limestone)

Ostrea vicksburgensis Conrad (Shubuta Member of Yazoo Clay, Red Bluff Clay, and Marianna Limestone)

Pecten perplanus Morton (Red Bluff Clay)

Pecten poulsoni Morton (Marianna Limestone)

Periarchus lyelli pileussinensis (Ravenel) (Pachuta Marl Member and Cocoa Sand Member of Yazoo Clay)

Spondylus dumosus (Morton) (Shubuta Member of Yazoo Clay and Red Bluff Clay)
Terebratulina lachryma (Morton) (Shubuta Member of Yazoo Clay)

Microfossils, although not identifiable in the field, occur in greater diversity and with greater continuity. The diversity and abundance of ostracods and foraminifers provide an excellent opportunity for zonation and correlation of these sediments. Biostratigraphic procedures, however, are more complex because they are based on assemblages rather than on index or key species.

A biostratigraphic analysis based on only one of the three taxonomic groups used in this study would give results strongly affected by ecologic variations in the sediments. Greatly different taxonomic groups are not likely to be controlled in the same way by ecologic variations. For this reason, three groups (benthonic foraminifers, planktonic foraminifers, and ostracods) were studied so that the biostratigraphic data from each would serve as a check on the others. Biostratigraphic boundaries based on these three groups of microfossils are consistent throughout the area of study.

In each of the sections used in the study, the zonal boundaries were established at the major discontinuities shown by each of the faunal groups. Although these discontinuities were identified visually for planktonic foraminiferal and ostracod data, the benthonic foraminifers are so diversified that successive samples in each section had to be compared by calculating a numerical coefficient of faunal resemblance. Simpson's (1947, 1960) coefficient is calculated as $\frac{100\ C}{N_1}$, where C represents the number of taxa common to the two faunules being compared and N_1 is the number of taxa in the less diversified faunule. Simpson's coefficient is superior over more conventional percentage coefficients because it minimizes differences in diversity of the faunules being compared, and, thus, of ecological differences (Cheetham, written communication, 1960). For the purposes of this study, coefficients of 70 percent or less were taken to suggest faunal discontinuity, coefficients between 71 and 85 percent to indicate moderate resemblance, and coefficients of 85 percent or more to indicate close resemblance.

FAUNAL ZONES

FLORIDINA ANTIQUA ZONE

The sandy marls and sands (Pachuta Marl Member and Cocoa Sand Member of Yazoo Clay) of the upper Jacksonian Stage were included in an assemblage zone, the *Floridina antiqua* zone, by Cheetham (written communication, 1959), on the basis of cheilostome bryozoans. The abundance of bryozoans and *Chlamys spillmani* in beds of this zone accounts for the name "*Pecten*-Bryozoa bed" commonly applied to them (Smith and others, 1944).

The top of the *Floridina antiqua* zone is characterized by the last occurrences of *Clithrocytheridea garretti, C. grigsbyi, Brachycythere watervalleyensis, "Cythereis" hysonensis, Sigmomorphina costifera, Textularia dibollensis,* and *T. adalta.*

Species restricted to the *Floridina antiqua* zone are:

OSTRACODS

Brachycythere mississippiensis (Meyer)
Clithrocytheridea garretti (Howe and Chambers)
C. grigsbyi (Howe and Chambers)
Digmocythere watervalleyensis (Howe and Chambers)
Cyamocytheridea watervalleyensis (Stephenson)
"Cythereis" hysonensis (Howe and chambers)
Konarocythere spurgeonae (Howe and Chambers)
Cytheretta jacksonensis (Meyer)

BENTHONIC FORAMINIFERS

Sigmomorphina costifera Cushman
Textularia adalta Cushman
T. dibollensis Cushman and Applin
Siphonina advena eocenica Cushman and Applin

PLANKTONIC FORAMINIFERS

None

SPONDYLUS DUMOSUS ZONE

The body of sediments including the Shubuta Member of the Yazoo Clay, the Red Bluff Clay, and the Forest Hill Sand contains a distinctive fossil assemblage of megafossils, typified by *Spondylus dumosus*, and microfossils, including bryozoans, ostracods, and foraminifers. For this biostratigraphic unit, Cheetham (1957)

proposed the name *Spondylus dumosus* zone. This unit is easily recognizable across the 50-mile line of sections of this study, thinning from nearly 100 feet (mostly clay) in Wayne and Clarke Counties, Mississippi, to about 25 feet (marl and clay) at St. Stephens quarry and Little Stave Creek, Alabama, and to 12 feet (mostly marl) at Perdue Hill, Alabama.

Species restricted to this zone are:

OSTRACODS

Acanthocythereis n. sp. 1
Trachyleberis n. sp. 1
Buntonia israelskyi
Buntonia n. sp. 1
Pterygocythereis murrayi Hill

BENTHONIC FORAMINIFERS

Marginulina cocoaensis Cushman
Vulvulina advena Cushman
Saracenaria ornatula Cushman and Bermudez
Siphonina danvillensis Howe and Wallace
Pseudogaudryina jacksonensis Cushman
Astacolus danvillensis (Howe and Wallace)
Cancris cocoaensis Cushman
Discorbis cocoaensis Cushman and Garrett
Anomalina cocoaensis Cushman
Robulus rectidorsatus Bandy
Pseudoclavulina cocoaensis Cushman

PLANKTONIC FORAMINIFERS

Cribrohantkenina inflata (Howe)
Hastigerina danvillensis (Howe and Wallace)
Globorotalia cocoaensis (Cole)
Globigerina gortanii (Borsetti)
Globigerina pseudoampliapertura Blow and Banner

The ostracod and benthonic foraminiferal fauna of the *Spondylus dumosus* zone is more similar to the overlying *Lepidocyclina mantelli* zone than to the underlying *Floridina antiqua* zone (pls. 1-10; figs. 6, 7, 9). The planktonic foraminifers do not exhibit this distributional pattern; instead, the species *Cribrohantkenina inflata, Globigerina pseudoampliapertura, Hastigerina danvillensis* (pls. 1-

10) first occur at the base and become extinct within the zone. Thus, their ranges permit subdivision of the *Spondylus dumosus* zone into two subzones, the *Cribrohantkenina "danvillensis"* and the *"Cythereis" blanpiedi*.

The lower division, the *Cribrohantkenina "danvillensis"* subzone[1], contains a foraminiferal and ostracod assemblage that is different, but not distinct, from that of the upper part of the *Spondylus dumosus* zone (figs. 8, 10). It is not the intention to relegate the *Cribrohantkenina "danvillensis"* zone of Eames and others (1962) to subzonal rank on a world-wide basis, but the occurrence of the species[2] serves as a useful marker for local biostratigraphic correlation within the *Spondylus dumosus* zone.

The *Cribrohantkenina "danvillensis"* subzone contains the most diversified ostracod and foraminiferal assemblages of any of the biostratigraphic units encountered in the study. It contains a deeper water assemblage than shown by the other units, is bounded by the first and last occurrence of *Cribrohantkenina inflata*, and is characterized by the restricted occurrence of *Globorotalia cerroazulensis*, *Hastigerina danvillensis*, *Vulvulina advena*, *Anomalina cocoaensis*, *Discorbis cocoaensis*, *Marginulina cocoaensis*, *Sacracenaria ornatula*, *Acanthocythereis* n. sp. 1, and *Buntonia* n. sp. 1. An uncommon feature of this subzone is that it includes a horizon containing abnormal foraminiferal forms, such as a two-apertured *Uvigerina* (pl. 21; fig. 15) and a *Hantkenina alabamensis* with two spines at the base of one chamber and with bifurcating spines (pl. 15; figs. 5, 8). Another anomalous species is *"Darbyella" danvillensis* that is probably an abnormal *Robulus* with the last chamber deviating from the plane of coiling. These forms do not occur sporadically, but they are commonly present at one horizon across the entire line of sections.

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[1] The section exposed at St. Stephens quarry from the first to the last occurrence of *Cribrohantkenina danvillensis*, *Globorotalia cocoaensis*, *Acanthocythereis* n. sp. 1, and *Marginulina cocoaensis* is designated as the type section for this subzone. Lithologically, this subzone includes the sediments of the Shubuta Member of the Yazoo Clay, consisting of 6 feet of gray marl overlain by 2 feet of bluish-gray clay.

[2] Spraul (1962), in a study of the genus *Cribrohantkenina*, placed all the species described in *Cribrohantkenina* in *Cribrohantkenina inflata*. This interpretation appears valid, because there is no distributional pattern (stratigraphic or geographic) of morphological differences. The species is referred to as *Cribrohantkenina inflata* in this report; however, the original zonal name has been retained to avoid confusion.

The upper subdivision of the *Spondylus dumosus* zone, the *"Cythereis" blanpiedi*[1] subzone, appears to correlate with the lower part of the *Globigerina ampliapertura* zone of Eames and others (1962); however, as the species is not as abundant and consistent as *"Cythereis" blanpiedi*[2] in the area studied, the subzone is named for the latter species. This subzone is characterized by the first occurrence of *"Cythereis" blanpiedi* and *Globigerina ampliapertura*. The species *Hantkenina alabamensis* was found in this zone, but their poor state of preservation led the writer to agree with Eames and others (1962) that the specimens were reworked from lower deposits.

Species occurring in the *"Cythereis" blanpiedi* subzone but not in the *Cribrohantkenina "danvillensis"* subzone are:

OSTRACODS

"Cythereis" blanpiedi Howe
Echinocythereis mcguirti (Howe)
Propontocypris mississippiensis (Howe and Law)

BENTHONIC FORAMINIFERS

Bolivina mississippiensis Cushman
Discorbitura dignata Bandy
Angulogerina byramensis (Cushman)
A. vicksburgensis Cushman
Palmula caelata (Bermudez)
Robulus vicksburgensis (Cushman)

PLANKTONIC FORAMINIFERS

Globigerina ampliapertura Bolli

---

[1] The section exposed at St. Stephens quarry from the first occurrence of *"Cythereis" blanpiedi, Globigerina ampliapertura, Discorbitura dignata* and *Eponides mariannaensis* to the lowest occurrence of, but not including, *Lepidocyclina mantelli* is designated as the type section for this subzone. The subzone includes the Red Bluff Clay, which consists of 10 feet of interbedded limestone and clay that is underlain by 4 feet of brown-gray clay.

[2] This species was placed in the genus *Trachyleberidea* by Bowen (1953), but *"Cythereis" blanpiedi* Howe has been retained for the subzone because the name is more commonly used in the Gulf Coastal Plain.

LEPIDOCYCLINA MANTELLI ZONE

The soft white limestone and gray glauconitic marl of the Marianna Limestone contain abundant *Lepidocyclina mantelli* and *Pecten poulsoni*, and yielded a distinctive microfaunal assemblage. Although this study included only the lower 10 to 15 feet of this unit, the writer recognized it as a distinct biostratigraphic unit for which here he proposes the name *Lepidocyclina mantelli* zone.

The planktonic foraminifers indicate that this zone is correlative with a part of the *Globigerina ampliapertura* bearing beds of other parts of the world (Eames and others, 1962), but the exact relationship was beyond the scope of this study.

Species restricted to the *Lepidocyclina mantelli* zone are:

OSTRACODS

Hemicythere kniffeni Howe and Law
Paracypris rosefieldensis Howe and Law
Ambocythere n. sp. 1
Jugosocythereis vicksburgensis (Howe and Law)
Propontocypris mississippiensis (Howe and Law)

BENTHONIC FORAMINIFERS

Textularia tumidulum Cushman
Textularia conica d'Orbigny
Cancris n. sp. 1
Guttulina problema Cushman
Planorbulina larvata Parker and Jones

PLANKTONIC FORAMINIFERS

Globigerinita dissimilis (Cushman and Bermudez)

---

[1] The section exposed at St. Stephens quarry, from the lowest to the highest occurrence of *Lepidocyclina mantelli* and *Pecten poulsoni*, is designated as the type section of this zone. Lithologically, it includes 60 feet of soft, light-blue to buff limestone of the Marianna Limestone, underlain by the dark-brown clay of the Forest Hill Sand, and overlain by the crystalline Glendon Limestone Member of the Byram Formation.

FAUNAL ANALYSIS

OSTRACODS

Fifty-nine species of ostracods occur in the samples studied (fig. 4). The most diversified assemblage occurs in the *Spondylus dumosus* zone (fig. 5), but the other zones have relatively high diversity also. Coefficients of faunal resemblance show the greatest variation for ostracod data. The upper and middle zones have a resemblance of 71 percent, but the middle and lower zones have a resemblance of only 35 percent.

The most striking change in the ostracod fauna is the extinction of all but 3 of 8 species of merodont hinged ostracods at the boundary between the *Floridina antiqua* zone and the *Spondylus dumosus* zone. A definite change in an important morphologic feature in ostracods does not occur at the top of the *Spondylus dumosus* zone. At a minor discontinuity within the *Spondylus dumosus* zone, five species of related trachyleberids become extinct and are replaced by *Trachyleberidea blanpiedi*.

PLANKTONIC FORAMINIFERS

The planktonic foraminifers are the least diversified of the groups studied (figs. 4, 5), but their mode of life makes them especially significant in inter-provincial correlation. Of the 18 species of planktonic foraminifers, 17 occur in the *Cribrohantkenina "danvillensis"* subzone (fig. 5) and must have been deposited in fairly deep water. The number of species of planktonic foraminifers occurring in the *Lepidocyclina mantelli* and *Floridina antiqua* zones was 7 and 8, respectively, and both units probably were deposited in shallower waters.

The coefficients of faunal resemblance are not considered significant in the comparison of the planktonic foraminiferal assemblages between zones, because of the small number of species. All the species from the *Floridina antiqua* zone occur in the *Spondylus dumosus* zone. All but one species from the *Lepidocyclina mantelli* zone are present in the zone below. The faunal resemblance indices (fig. 9) are not considered reliable for vertical zonation, because they are based on the absence or presence of only one species.

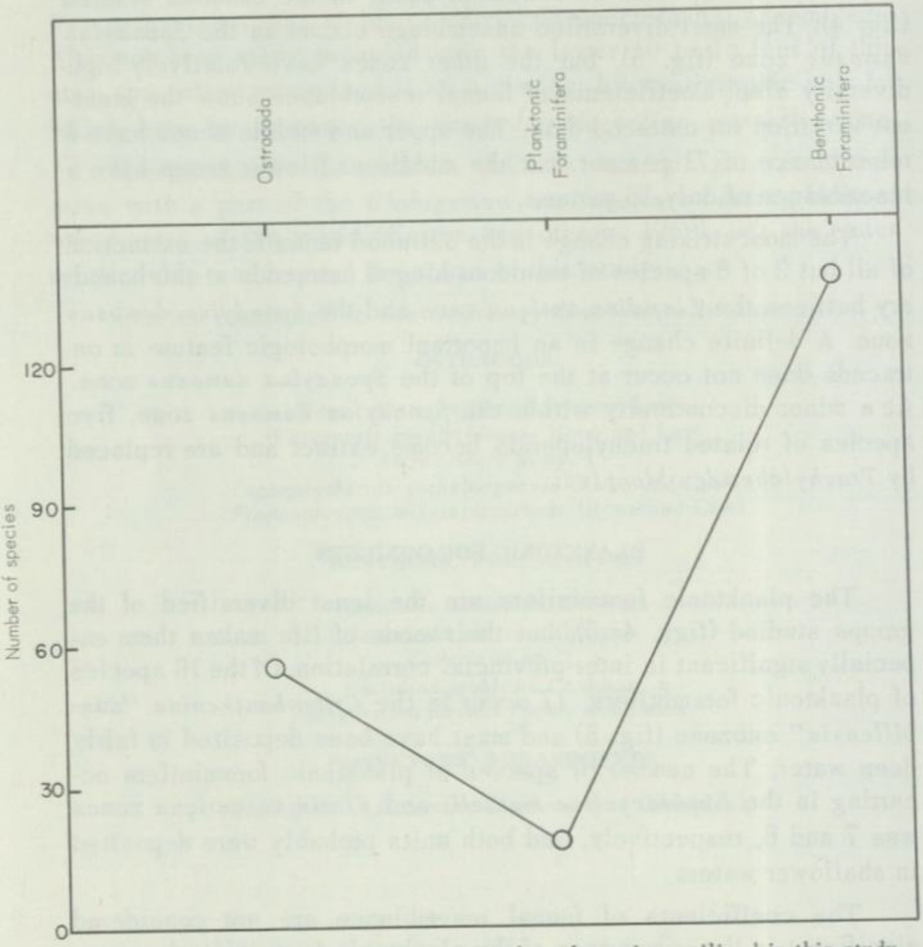


Figure 4.—Diversity of organisms, in number of species, utilized in this study.

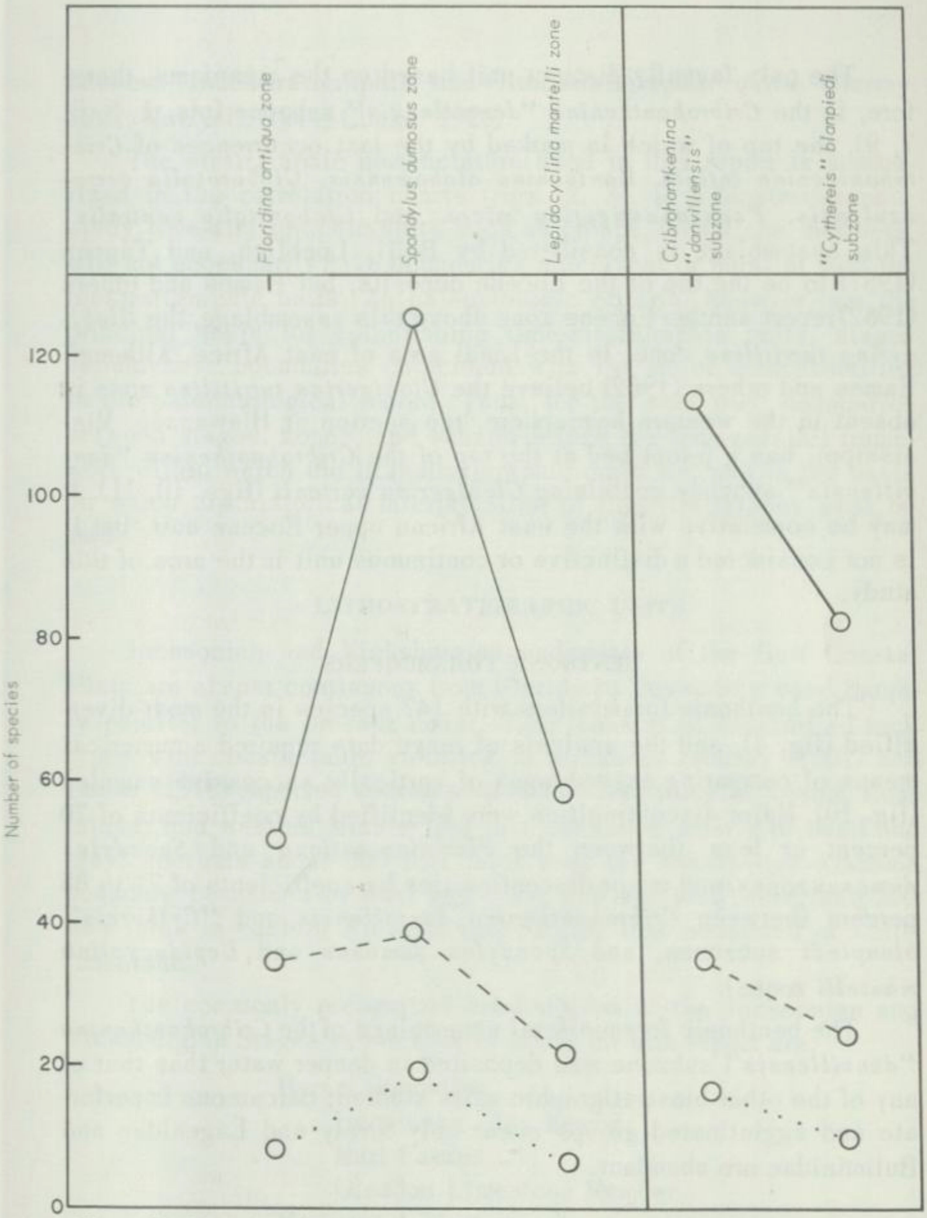


Figure 5.—Diversity of organisms, in number of species, in biostratigraphic units recognized in this study. ----Ostracods, ——Benthonic foraminifers, ... Planktonic foraminifers.

The only faunally distinct unit based on the organisms, therefore, is the *Cribrohantkenina "danvillensis"* subzone (pls. 1, 3, 5, 7, 9), the top of which is marked by the last occurrences of *Cribrohantkenina inflata, Hantkenina alabamensis, Globorotalia cerroazulensis, Pseudohastigerina micra,* and *Globorotalia centralis*. This assemblage is considered by Bolli, Loeblich, and Tappan (1957) to be the top of the Eocene deposits, but Eames and others (1962) report another Eocene zone above this assemblage, the *Globigerina turritilina* zone, in the Lindi area of east Africa. Although Eames and others (1962) believe the *Globigerina turritilina* zone is absent in the western hemisphere, the section at Hiawannee, Mississippi, has a 5-foot bed at the top of the *Cribrohantkenina "danvillensis"* subzone containing *Globigerina gortanii* (figs. 10, 11). It may be correlative with the east African upper Eocene unit, but it is not considered a distinctive or continuous unit in the area of this study.

BENTHONIC FORAMINIFERS

The benthonic foraminifers with 147 species is the most diversified (fig. 4), and the analysis of range data required a numerical means of comparing assemblages of vertically successive samples (fig. 10). Major discontinuities were identified by coefficients of 70 percent or less (between the *Floridina antiqua* and *Spondylus dumosus* zones) and minor discontinuities by coefficients of 71 to 85 percent (between *Cribrohantkenina danvillensis* and *"Cythereis" blanpiedi* subzones, and *Spondylus dumosus* and *Lepidocyclina mantelli* zones).

The benthonic foraminiferal assemblage of the *Cribrohantkenina "danvillensis"* subzone was deposited in deeper water than that of any of the other biostratigraphic units studied; calcareous imperforate and agglutinated groups occur only rarely and Lagenidae and Buliminidae are abundant.

STRATIGRAPHIC IMPLICATIONS OF FAUNAL STUDY

Deposits of Jacksonian and Vicksburgian age have been studied extensively by Gulf Coast stratigraphers who have given general or detailed accounts of regional and local relationships

between time-stratigraphic and lithostratigraphic units (Murray, 1961; MacNeil, 1944; Cooke, 1926).

The stratigraphic nomenclature used in this report is summarized in the correlation charts (figs. 2, 3). In a biostratigraphic study, time-stratigraphic units such as groups, formations, members, will not necessarily have boundaries coincident or parallel with the biostratigraphic units. As paleontologic criteria, however, are the principal basis for establishing time-stratigraphic units, stages should have boundaries coincident with the major discontinuities in the paleontological record. Thus, for the most part, boundaries between stages, zones, and subzones form the time-parallel framework within which the lithostratigraphic units lie, and is the basis on which the historical interpretation of lithostratigraphy must be made.

LITHOSTRATIGRAPHIC UNITS

Jacksonian and Vicksburgian sediments of the Gulf Coastal Plain are almost continuous from Florida to Texas in a band roughly parallel to the present coast. They consist of diversified rock types with considerable variation in thickness. Murray (1961) and Cooke (1918) reported sections up to 600 feet thick in Texas, Louisiana, and western Mississippi that consisted mostly of sand and clay; sections about 300 feet thick near the Mississippi-Alabama boundary composed of marl and clay; and sections more than 200 feet thick in eastern Alabama and Florida that consisted of white limestone.

The commonly recognized subdivisions of the Jacksonian and Vicksburgian Stages in the area of study for this report are:

Byram Formation
- Bucatunna Clay Member
- Marl Facies
- Glendon Limestone Member

Marianna Limestone
- Upper Unnamed Member
- Mint Spring Marl Member

Forest Hill Sand
Red Bluff Clay
Yazoo Clay
    Shubuta Member
    Pachuta Marl Member
    Cocoa Sand Member
    North Creek Member
Moodys Branch Formation

The units sampled in the study for this report are as follows:

COCOA SAND MEMBER OF YAZOO CLAY

The Cocoa Sand Member of Yazoo Clay consists of bluish-gray sand with indurated calcareous ledges and is about 25 to 50 feet thick in northeastern Wayne County, Mississippi, and Choctaw County, Alabama. At Shubuta Hill near Shubuta, Mississippi, it is a brown calcareous sand that grades upward into the Pachuta Marl Member. Eastward, at Little Stave Creek in Clarke County, Alabama, the Cocoa Sand Member may be represented by the lower more sandy 2 feet of the "*Pecten*-Bryozoa bed" (Smith, R. H., and others, 1944). East of Little Stave Creek, the Cocoa is not present, and the Pachuta Marl Member rests on the North Creek Member.

PACHUTA MARL MEMBER OF YAZOO CLAY

The Pachuta Marl Member is buff to white sandy fossiliferous marl ranging from 5 to 10 feet in thickness from the Mississippi-Alabama boundary to Perdue Hill, Alabama.

SHUBUTA MEMBER OF YAZOO CLAY

This unit consists of 75 feet of light-gray-green clay at Shubuta Hill that thins eastward to 7 feet of greenish-gray to tan marl at Perdue Hill.

RED BLUFF CLAY

The Red Bluff Clay consists of 18 to 20 feet of dark-greenish-gray clay at the type locality at Hiwannee, Mississippi. It thins eastward to light-gray to buff glauconitic marl, locally containing

hard limestone ledges.

FOREST HILL SAND

The sand and lignitic clay of the Forest Hill Sand interfinger with the Red Bluff Clay near the Mississippi-Alabama boundary. The Forest Hill consists of 10 feet of brown-black lignitic fossiliferous clay at St. Stephens quarry. In Wayne County, Mississippi, the unit is unfossiliferous.

MINT SPRING MARL MEMBER OF MARIANNA LIMESTONE

The type locality of this unit at Vicksburg, Mississippi, lies beneath the falls along Mint Spring Bayou. It consists of 12 feet of fossiliferous bluish-gray glauconitic marl that thins to 2 feet in Wayne County, Mississippi (pls. 1, 2), and pinches out farther to the east.

UPPER UNNAMED MEMBER OF MARIANNA LIMESTONE

The soft light-blue to white "Chimney Rock" limestone of the unit is uniform in lithology from Marianna, Florida, to Mississippi. It thickens from approximately 30 feet at Marianna to 60 feet in western Alabama and thins again to 30 feet in eastern Mississippi. Only the lower 10 feet of the unit was sampled.

JACKSONIAN-VICKSBURGIAN BOUNDARY

The position of the Jacksonian-Vicksburgian boundary has previously been determined chiefly on lithologic evidence. MacNeil (1944) and Murray (1947) considered the Red Bluff Clay and Forest Hill Sand to be between the Jacksonian and the Vicksburgian Stages. Later, Murray (1952a) correlated these sediments with the lower part of the Moseley Hill in Louisiana, which he placed in the Vicksburgian. Cooke (1945) and Toulmin (1955) recognized the Vicksburgian affinities of the Red Bluff-Forest Hill fauna in Alabama. Moore (1955), however, considered the Bumpnose Limestone Member of Crystal River Limestone (Ocala Group) of Florida as correlative with the Red Bluff Clay, and, by implication, placed both in the Jacksonian. Cheetham (1957), on the basis of a cheilostome bryozoan study, concluded that the Red Bluff Clay and the

Shubuta Member of the Yazoo Clay belong in a single biostratigraphic unit (*Spondylus dumosus* zone) having closer affinities with the Vicksburgian than with the Jacksonian and that the boundary between the Eocene Series and Oligocene Series in the Eastern Gulf Coast region should be placed at the base of this zone. Cheetham (1957) first placed the Shubuta Member of the Yazoo Clay in the Oligocene, although Monsour (1937), who referred the Red Bluff Clay to the Oligocene, considered the Shubuta fauna (ostracods and foraminifers) to be transitional between the typical Jacksonian and the Red Bluff in eastern Mississippi. Murray (1952a) indicated also that the Shubuta Member of the Yazoo Clay might belong with the Vicksburgian or in a stage between the Jacksonian and the Vicksburgian.

The faunal evidence obtained in the present study (figs. 6-11) lends support to Cheetham's (1957) conclusion regarding the resemblance of the fauna (*Spondylus dumosus* zone) of the Shubuta Member of the Yazoo Clay, Red Bluff Clay, and Forest Hill Sand to the fauna (*Lepidocyclina mantelli* zone) of the Mint Spring Marl Member of the Marianna Limestone. The writer, therefore, places the *Spondylus dumosus* zone in the Vicksburgian Stage. The designation of a separate stage between Jacksonian and Vicksburgian for the *Spondylus dumosus* zone does not appear justified by the degree of faunal difference between the *Spondylus dumosus* and *Lepidocyclina mantelli* zones.

EOCENE-OLIGOCENE BOUNDARY

MacNeil (1944), Cheetham (1957), Murray (1961), and other Gulf Coast stratigraphers considered the Jacksonian-Vicksburgian boundary to be the Eocene-Oligocene contact in the southeastern United States. As the *Cribrohantkenina inflata*-bearing beds, regarded by most micropaleontologists to be upper Eocene in age, lie above the major discontinuity here considered to be the Jacksonian-Vicksburgian contact, the two horizons do not appear to be coincident. In other words, the provincial time-stratigraphic units, Jacksonian and Vicksburgian Stages, do not have the same boundary as the world-wide time-stratigraphic units, the Eocene and Oligocene Series. The lower subdivision of the Vicksburgian, the *Spondylus dumosus*

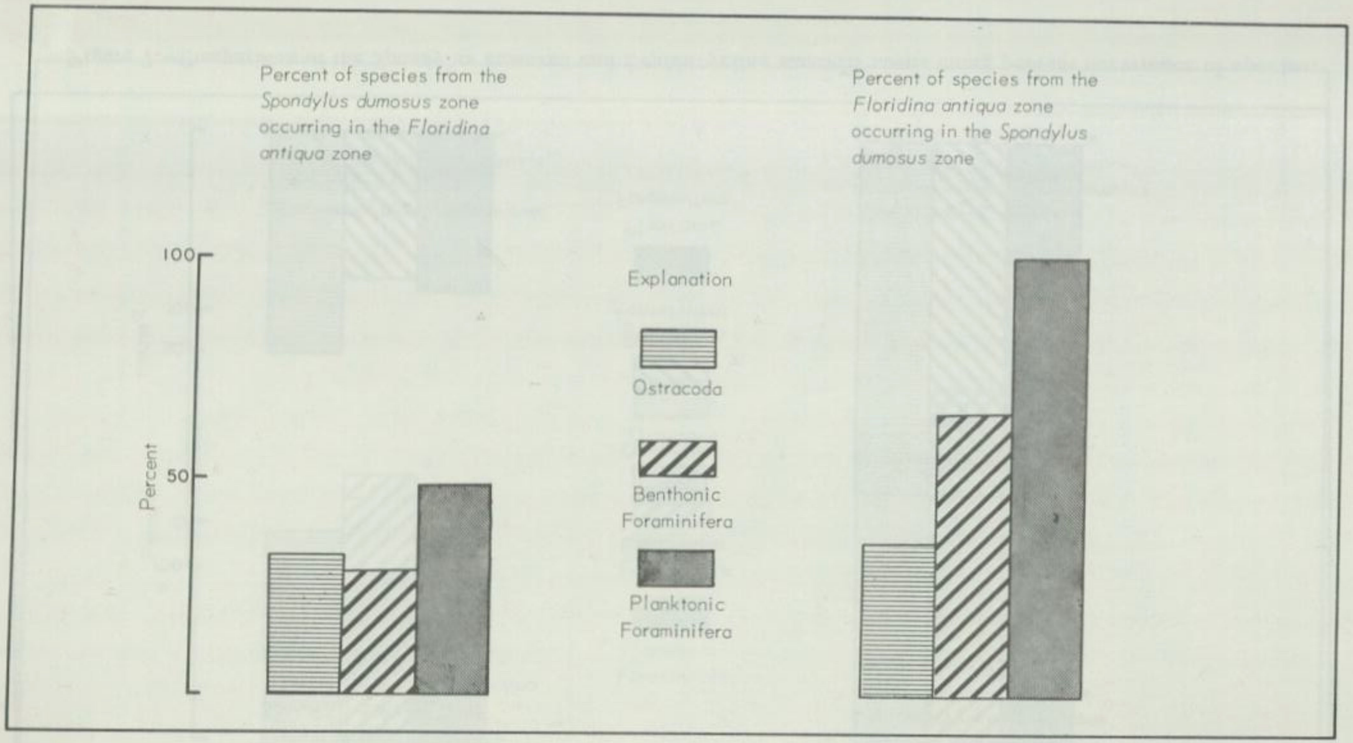

Percent of species from the Spondylus dumosus zone occurring in the Floridina antiqua zone
Percent of species from the Floridina antiqua zone occurring in the Spondylus dumosus zone
100
50
Percent
Explanation
Ostracoda
Benthonic Foraminifera
Planktonic Foraminifera

Figure 6.—Comparison of the *Floridina antiqua* and *Spondylus dumosus* zones using percent occurrence of species.

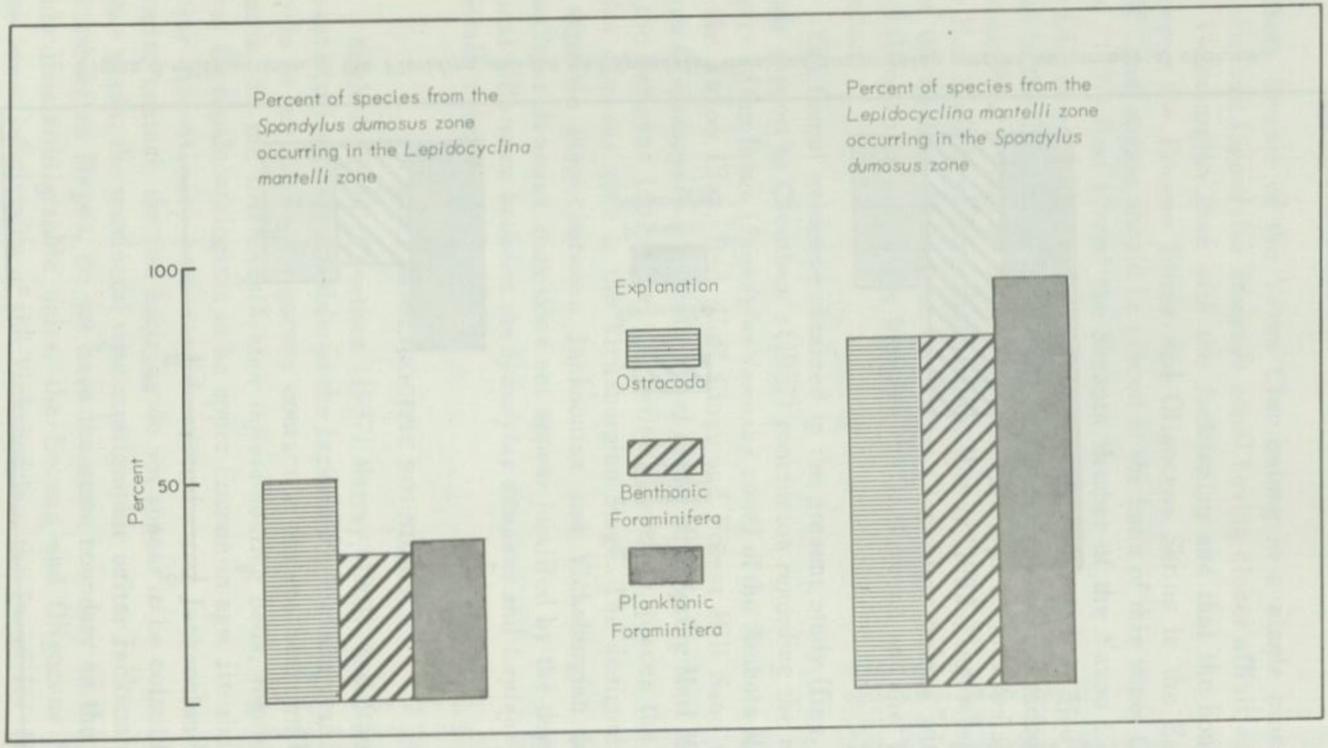

Percent of species from the Spondylus dumosus zone occurring in the Lepidocyclina mantelli zone
Percent of species from the Lepidocyclina mantelli zone occurring in the Spondylus dumosus zone
100
50
Percent
Explanation
Ostracoda
Benthonic Foraminifera
Planktonic Foraminifera

Figure 7.—Comparison of the *Spondylus dumosus* and *Lepidocyclina mantelli* zones using percent occurrence of species.

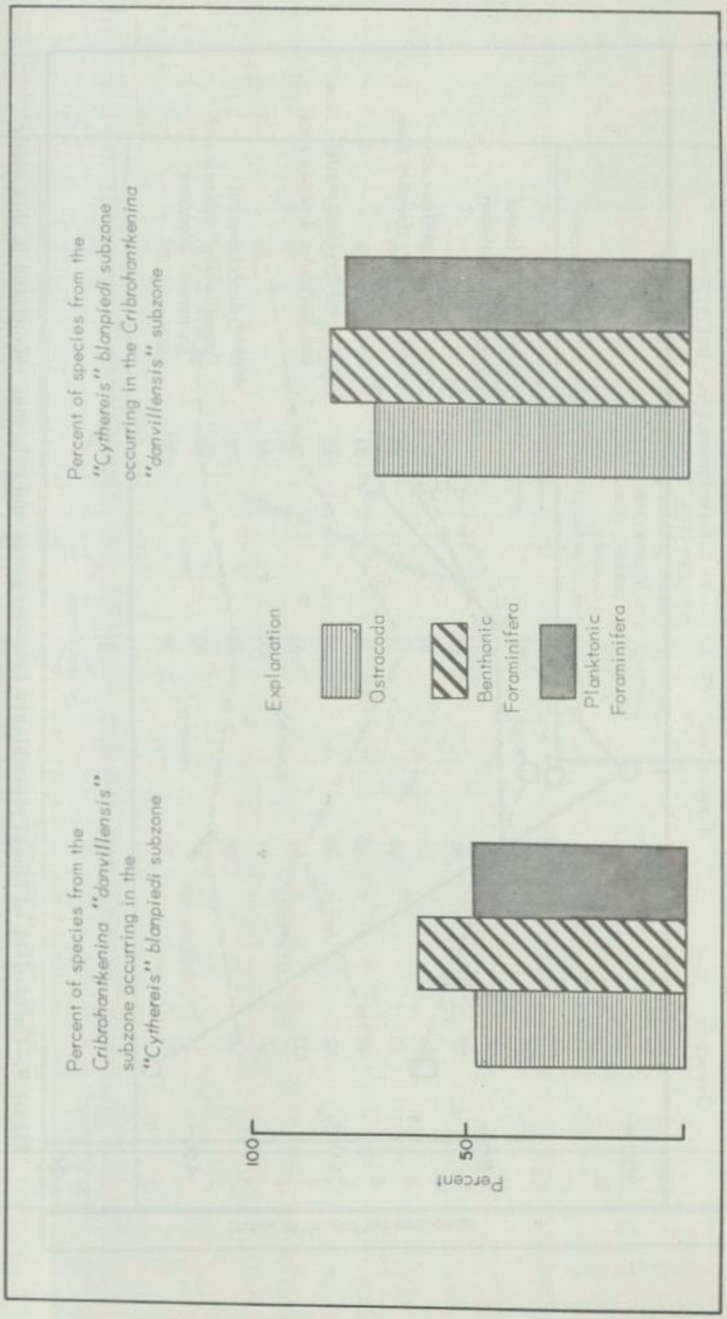


Figure 8.—Comparison of the *Cribrohantkenina "danvillensis"* and *"Cythereis" blanpiedi* subzones using percent occurrence of species.

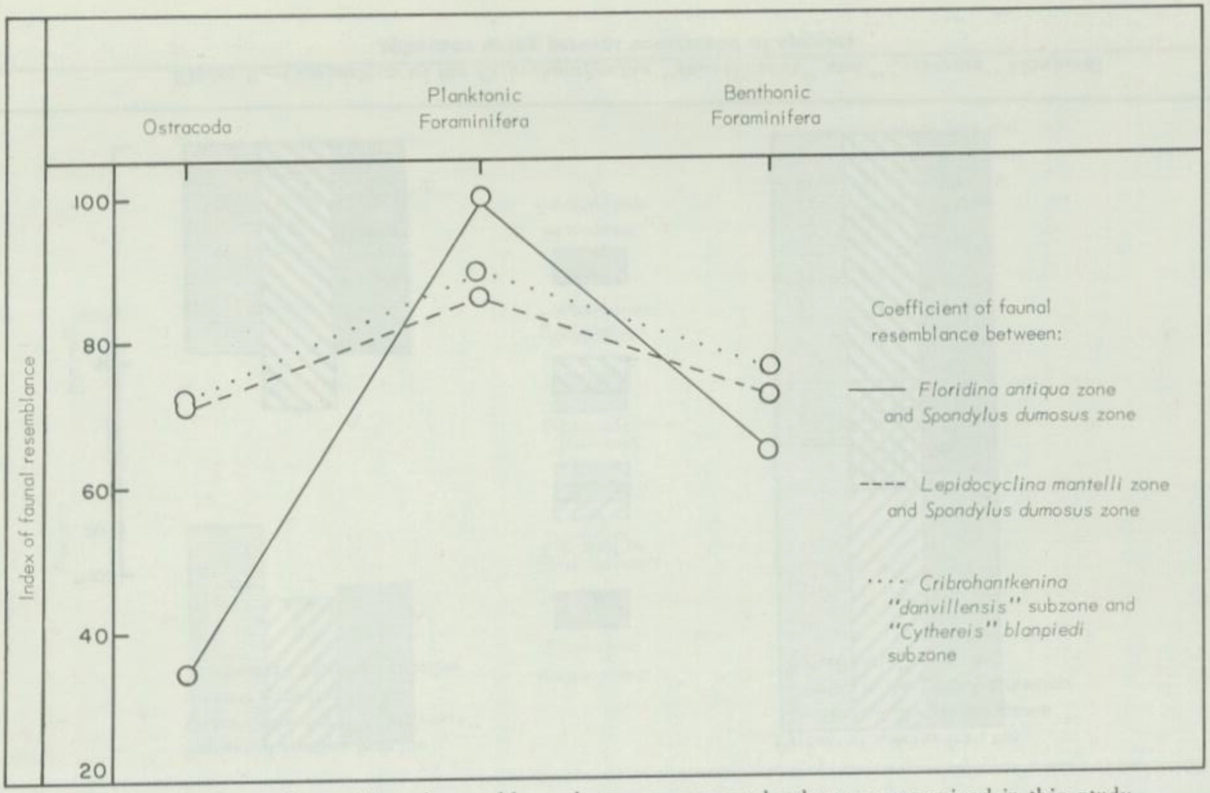


Figure 9.—Comparison of faunal resemblance between zones and subzones recognized in this study.

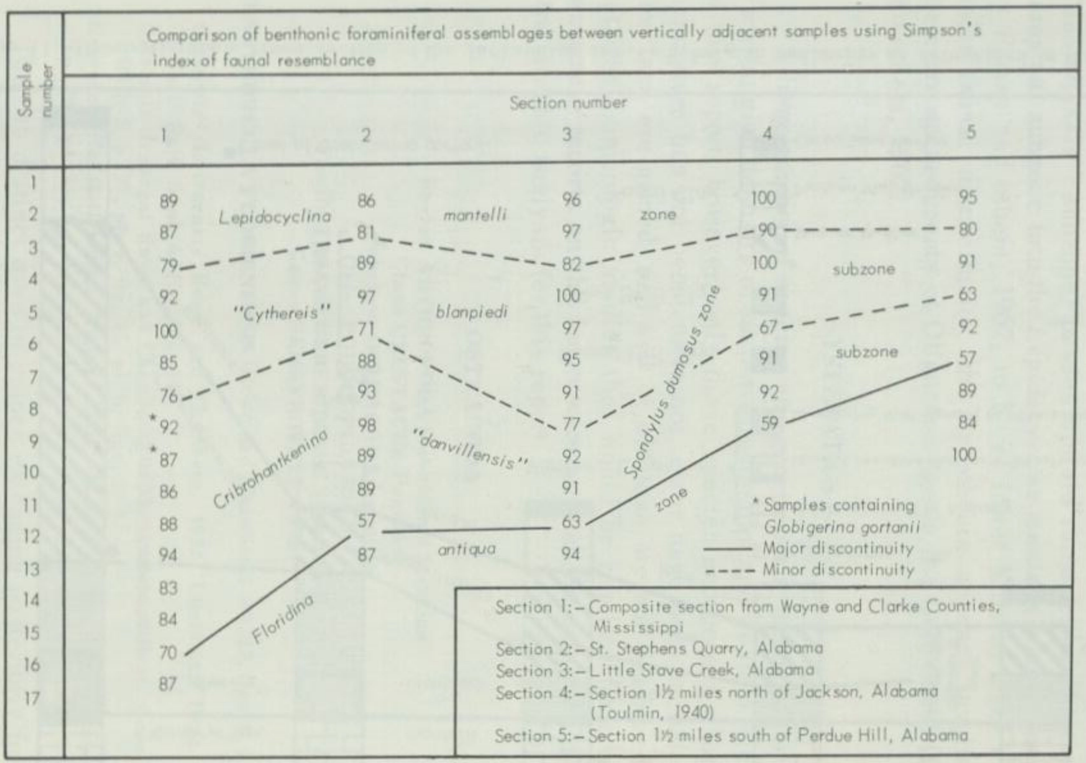


Figure 10.—Faunal resemblance between vertically adjacent samples based on benthonic foraminiferal assemblages.

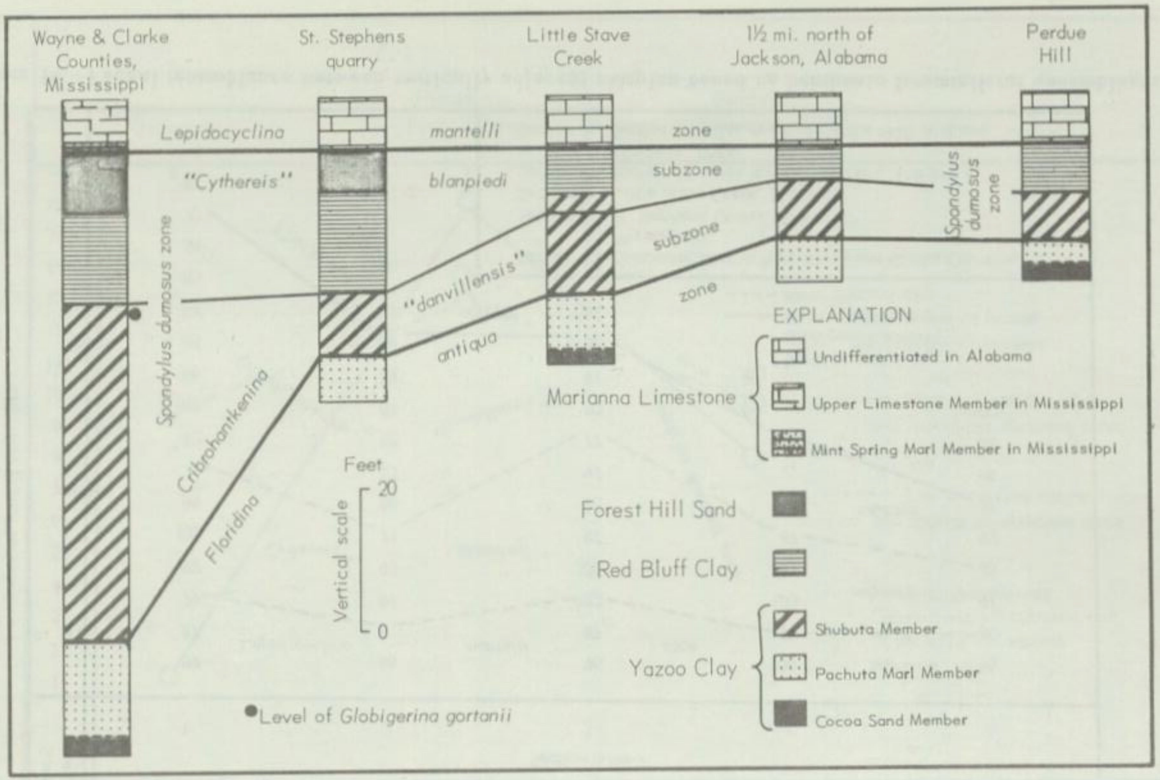


Figure 11.—Biostratigraphic cross section of the Jacksonian and Vicksburgian sediments as determined in this study.

zone, straddles the Eocene-Oligocene boundary, rather than lying above it as suggested by Cheetham (1957). Moreover, as the upper Eocene part of the *Spondylus dumosus* zone (the *Cribrohantkenina "danvillensis"* subzone) passes upward through the *"Cythereis" blanpiedi* subzone into the *Lepidocyclina mantelli* zone (considered by Eames and others, 1962, to be of lower Miocene age) without major faunal discontinuity, the hypothesis appears invalid that there are no sediments of Oligocene age in the Gulf Coast (Eames and others, 1962).

SYSTEMATICS

A large number of species and genera occur in the Jacksonian-Vicksburgian deposits of eastern Mississippi and western Alabama. In this report, however, only those species and genera whose nomenclature has not been, or is not, clear have been included. No new taxa are named, and new or old taxa are not described. The detailed morphologic studies that would be required for complete taxonomic reports on the fauna were beyond the scope of the biostratigraphic analysis for this report.

OSTRACODA

Phylum **ARTHROPODA** Siebold and Stannius
Class **CRUSTACEA** Pennant
Subclass **OSTRACODA** Latreille
Order **PODOCOPIDA** Mueller
Family **TRACHYLEBERIDIDAE** Sylvester-Bradley
Genus **HENRYHOWELLA** Puri

HENRYHOWELLA FLORIENENSIS (Howe and Chambers) Pl. 13, figs. 8, 9, 11, 12

Cythereis florienensis Howe and Chambers, 1935, Louisiana Dept. Cons., Geol. Bull. 5, pl. 6, figs. 14, 15.
Cythereis deusseni Howe and Chambers, 1935, Louisiana Dept. Cons., Geol. Bull. 5, p. 27, pl. 1, fig. 15, pl. 6, figs. 2, 3.
Henryhowella florienensis Krutak, 1961, Jour. Paleontology, v. 35, no. 4, p. 784, pl. 91, fig. 8.

The two distinct rows of spines extending posteriorly from the center of the lateral surface that are characteristic of the type species, *Henryhowella evax* (Canu and Bassler) 1904, are not distinctly evident in well-preserved specimens of *Henryhowella florienensis*

but are shown by slightly worn specimens (pl. 13, figs. 8, 9). *Henryhowella florienensis* is smaller and its posterior not as broadly rounded as *H. evax*.

Genus **ACANTHOCYTHEREIS** Howe

ACANTHOCYTHEREIS n. sp. 1 Pl. 14, figs. 14, 17

The species shows distinct morphologic affinities with *Henryhowella florienensis*, but none of the specimens examined show two rows of spines on the lateral surface—a generic trait of *Henryhowella*. Also, it is larger, has a more rounded posterior, and shows stronger sexual dimorphism than *H. florienensis*. The species is restricted to the *Spondylus dumosus* zone, whereas *H. florienensis* extends from the lower *Floridina antiqua* zone into the *Spondylus dumosus* zone.

Genus **ISOCYTHEREIS** Triebel

ISOCYTHEREIS COULEYCREEKENSIS (Gooch) Pl. 13, fig. 7

Cythereis couleycreekensis Gooch, 1939, Jour. Paleontology, v. 13, p. 584, pl. 67, figs. 1, 2, 3, 8.

"Cythereis" couleycreekensis Gooch is closely related to *"Cythereis" aranea* Jones and Sherborn. The median ridge, angling toward the postero-dorsal angle and ending in a low muscle node slightly in front of the center, is similar to that of *"Cythereis" aranea*. The shape in lateral view of the two species is also similar. Bowen (1953) placed *"C." aranea* in the genus *Trachyleberidea*, but recent research by Hazel (written communication, 1963) suggests that *"Cythereis" aranea* and related species belong in the genus *Isocythereis* Triebel, 1940.

Genus **TRACHYLEBERIDEA** Bowen

TRACHYLEBERIDEA BLANPIEDI (Howe) Pl. 13, figs. 10, 13

Cythereis *blanpiedi melvinensis* Howe. Howe and Law, 1936, Louisiana *Dept.* Cons., Geol. Bull. 7, p. 4, pl. 5, fig. 22.

Cythereis blanpiedi Howe. Howe and Law, 1936, Louisiana Dept. Cons., Geol. Bull. 7, pl. 4, fig. 27, pl. 5, fig. 8.

"Cythereis" blanpiedi Howe is closely related to *Cythereis prestwichiana* Jones and Sherborn, the type species of which was placed in the genus *Trachyleberidea* Bowen. The angulate posterior, the pronounced muscle node, the denticulations within the reticulations, and a ridge extending from the postero-ventral angle around the anterior and ending near the middle of the dorsal part of the lateral surface suggest that this species is related to *"Cythereis" prestwichiana* and, thus, should belong in the genus *Trachyleberidea*.

FORAMINIFERA

Phylum **PROTOZOA**
Class **RHIZOPODA** von Siebold
Order **FORAMINIFERA** d'Orbigny
Superfamily **GLOBIGERINACEAE** Carpenter
Family **HANTKENINIDAE** Cushman
Genus **CRIBROHANTKENINA** Thalmann

CRIBROHANTKENINA INFLATA (Howe) Pl. 15, figs. 4, 6

Hantkenina inflata Howe, 1938, Jour. Paleontology, v. 2, p. 13, 14, fig. 2.
Hantkenina mccordi Howe and Wallace, 1932, Louisiana Dept. Cons., Geol. Bull. 2, p. 55, 56, figs. 1a, 1b.
Hantkenina danvillensis Howe and Wallace, 1934, Jour. Paleontology, v. 8, no. 1, p. 35-37, pl. 5, figs. 14-17.
Hantkenina (Cribrohantkenina) bermudezi Thalmann, 1942, Am. Jour. Sci., v. 240, p. 812, 815, 819, pl. 1, figs. 5, 6.
Cribrohantkenina bermudezi Thalmann. Bolli, Loeblich, and Tappan, 1957, U.S. Nat. Mus. Bull. 215, p. 28, 29, pl. 2, figs. 9a-11b.
Cribrohantkenina danvillensis (Howe and Wallace). Blow and Banner, 1962, Mid-Tertiary Stratigraphical Correlation: Cambridge University Press, pt. 2, p. 128-129, pl. 16, figs. g, h.
Cribrohantkenina inflata (Howe). Spraul, 1962, Gulf Coast Assoc. Geol. Soc. Trans., v. 12, p. 343-347, pl. 1, figs. 1a-4b.

Spraul (1962) suggested that *H. inflata, H. mccordi, H. danvillensis,* and *H. (Cribrohantkenina) bermudezi* are conspecific. The apertural differences, the globosity of the younger chambers, and the length of the spines, which may possibly constitute specific differences, seem to be gradational and not restricted geographically or stratigraphically.

Family **GLOBIGERINIDAE** Carpenter
Subfamily **GLOBOROTALINAE** Cushman
Genus **GLOBOROTALIA** Cushman

GLOBOROTALIA CERROAZULENSIS (Cole) Pl. 15, figs. 13, 14, 17-20.

Globigerina cerro-azulensis Cole, 1929, Am. Paleontology Bull., v. 14, no. 53, p. 217, pl. 32, figs. 11-13.
Globorotalia cocoaensis Cushman, 1928, Contr. Cushman Lab. Foram. Res., v. 4, pt. 3, p. 75, pl. 10, figs. 3a-c; Cushman, 1935, U.S. Geol. Survey Prof. Paper 181, p. 50, pl. 21, figs. 1a-3c; Bolli, 1957, U.S. Nat. Mus. Bull. 215, p. 169, pl. 39, figs. 5a-7b.
Globorotalia (Turborotalia) cerro-azulensis (Cole). Blow and Banner, 1962, Mid-Tertiary Stratigraphical Correlation: Cambridge University Press, pt. 2, p. 118, pl. 12, figs. d-f.

Globigerina cerroazulensis Cole and *Globorotalia cocoaensis* Cushman are apparently conspecific. The species exhibits a gradation from a distinctly keeled periphery to an angulate periphery to a rounded periphery. The size of the aperture is also variable. The characters are gradational and do not show any geographic or stratigraphic pattern.

Genus **PSEUDOHASTIGERINA** Banner and Blow

PSEUDOHASTIGERINA MICRA (Cole) Pl. 15, figs. 1-3

Nonion micrus Cole, 1927, Am. Paleontology Bull., v. 14, no. 51, p, 22, pl. 5, fig. 12; Monsour, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 1, p. 85.
Hastigerina micra (Cole). Bolli, 1957, U.S. Nat. Mus. Bull. 215, p. 161, pl. 35, figs. 1a-2b.
"Globigerinella" iota (Finlay). Hornibrook, 1958, Micropaleontology, v. 4, no. 1, p. 34, pl. 1, figs. 22-24.
Pseudohastigerina micra (Cole). Banner and Blow, 1959, Paleontology, v. 2, pt. 1, p. 19-20, pl. 3, figs. 6a-b, text figs. 4g-i.

The species shows early trochoid chambers, moderately inflated chambers, and coarsely perforate test wall. The initial chambers are commonly evident at the umbilical whorl and assignment to *Pseudohastigerina* seems to be correct.

Family **UVIGERINIDAE** Cushman
Subfamily **UVIGERININAE** Cushman
Genus **STILOSTOMELLA** Guppy

STILOSTOMELLA COCOAENSIS (Cushman) Pl. 22, fig. 21

Nodosaria cocoaensis Cushman, 1925, Contr. Cushman Lab. Foram. Res., v. 1, p. 66, pl. 10, figs. 5, 6.
Dentalina cocoaensis (Cushman). Cushman, 1927, Jour. Paleontology, v. 1, p. 153, pl. 24, fig. 14.
Ellipsonodosaria cocoaensis (Cushman). Cushman, 1939, Contr. Cushman Lab. Foram. Res., v. 15, p. 68, pl. 11, figs. 27, 33.
Nodosarella cocoaensis (Cushman). Bandy, 1949, Am. Paleontology Bull., v. 32, no. 131, pl. 7, figs. 2a, b.

Bandy (1949) states that the type species of *Ellipsonodosaria* Sylvestri and *Nodosarella* Rzehak are congeneric. Finlay (1947) and Pokorny (1958) recognize *Stilostomella* Guppy as the senior synonym of both genera. Stainforth (1952b) states:

> Finlay strongly urges the suppression of *Ellipsonodosaria* as a synonym of *Nodosarella*. He cites Martinotti to the effect that the early chambers of *Nodosarella* may be biserial in the microspheric form. (Stainforth, 1952a, preferred to regard *Nodosarella* as strictly uniserial and to use *Ellipsoidella* for the initially biserial forms, but recognized the difficulty of separating marginal species).
>
> Finlay recognizes the synonomy of *Siphonodosaria* and *Nodogenerina* but draws attention to an awkward taxonomic point. *Siphonodosaria* Silvestri, 1924, was proposed as a genus with no designated species and ought to be considered a nude name until it was validated by Cushman, who referred *Nodosaria abyssorum* Brady to this genus in March 1927. Meanwhile *Nodogenerina* Cushman had been proposed, with *N. bradyi* as genotype, in January 1927. It can be argued from these facts that *Nodogenerina* has prior validity over *Siphonodosaria*. Finlay leaves this question open and goes on to claim that *Stilostomella* Guppy, 1894 is congeneric with *Siphonodosaria* and *Nodogenerina* and has priority over both of them. Stainforth, 1952a, considered that *Siphonodosaria* was the valid name by priority of publication. He overlooked *Stilostomella* but here states the opinion that Finlay appears to be correct.

STILOSTOMELLA JACKSONENSIS (Cushman and Applin) Pl. 22, fig. 33

Nodosaria jacksonensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 170, pl. 7, figs. 14-16.
Dentalina jacksonensis (Cushman and Applin). Cushman, 1935, U.S. Geol. Survey Prof. Paper 181, p. 20, pl. 8, figs. 7-9.
Siphonodosaria jacksonensis (Cushman and Applin). Stainforth, 1952a, Contr. Cushman Lab. Foram. Res., v. 3, pt. 1, p. 12.

The remarks pertaining to the generic placement of *Stilostomella cocoaensis* also apply to this species.

Family **CAUCASINIDAE** Bykova
Subfamily **FURSENKOININAE** Loeblich and Tappan
Genus **FURSENKOINA** Loeblich and Tappan

FURSENKOINA DIBOLLENSIS (Cushman and Applin) Pl. 22, figs. 22, 23

Virgulina dibollensis Cushman and Applin, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 168, pl. 7, fig. 7.
Virgulina dibollensis var. *subtransversalis* Bandy, 1949, Am. Paleontology Bull., v. 32, no. 131, p. 137, pl. 26, figs. 10a-b.

Loeblich and Tappan (1961) state:

> *Fursenkoina nom. nov.* is herein proposed for *Virgulina* d'Orbigny, 1826, Ann. Sci., Nat. v. 7, p. 267 *(non Virgulina* Bory de St. Vincent, 1823). Type species: *Fursenkoina squammosa* (d'Orbigny) = *Virgulina squammosa* d'Orbigny, 1826.

Superfamily **NODOSARIACEA** Ehrenberg
Family **NODOSARIIDAE** Ehrenberg
Subfamily **NODOSARIINAE** Ehrenberg
Genus **LANKESTERINA** Loeblich and Tappan

LANKESTERINA FRONDEA (Cushman) Pl. 20, figs. 2, 3

Bolivina frondea Cushman, 1922, U.S. Geol. Survey Prof. Paper 129-F, p. 126, pl. 29, fig. 3.
Polymorphina frondea (Cushman). Cushman, 1929, Contr. Cushman Lab. Foram. Res., v. 5, p. 41.

Loeblich and Tappan (1961) comment on the generic assignment of this species as follows:

> Originally described as *Bolovina*, the type species of the present genus was later transferred to *Polymorphina* by Cushman (1929) because of the radial aperture, which

was illustrated by Cushman and Ozawa (1930). *Lankesterina* differs from *Polymorphina* in being completely symmetrical throughout and in having truncate margins, similar to the other palmate genera of the Nodosariinae *(Dyofrondicularia, Frondicularia,* etc.), but differs from these in being biserial throughout. *Polymorphina* is somewhat asymmetrical particularly in its early development, and may show traces of a sigmoid development.

SELECTED BIBLIOGRAPHY

Bandy, O. L., 1949, Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke County, Alabama: Am. Paleontology Bull., v. 32, no. 131, 210 p.

Banner, F. T., and Blow, W. H., 1959, The classification and stratigraphical distribution of the Globigerinaceae: Paleontology, v. 2, pt. 1, p. 1-27.

_____1960, The taxonomy, morphology and affinities of the genera included in the subfamily Hastigerininae: Micropaleontology, v. 6, no. 1, p. 19-31.

Bold, William Aaldert van den, 1958a, Eocene and Oligocene Ostracoda of Trinidad: Micropaleontology, v. 6, no. 2, p. 145-196.

_____1958b, *Ambocythere*, a new genus of Ostracoda: Annals and Mag. Nat. Hist. [London], ser. 12, v. 10, no. 119, p. 801-813.

Bolli, H. M., 1957, Planktonic Foraminifera from the Eocene Navet and San Fernando Formations of Trinidad, B.W.I. *in* Loeblich, A. R., Jr., Studiesin Foraminifera: U.S. Natl. Mus. Bull. 215, p. 155-172.

Bolli, H. M., Loeblich, A. R., and Tappan, Helen, 1957, Planktonic foraminiferal families Hantkeninidae, Orbulinidae, Globorotaliidae and Globotruncanidae, *in* Loeblich, A. R., Jr., Studies in Foraminifera: U.S. Natl. Mus. Bull. 215, p. 3-50.

Bowen, R. N. C., 1953, Ostracoda from the London Clay: London Geol. Assoc. Proc., v. 64, pt. 4, p. 276-292.

Cheetham, A. H., 1957, Eocene-Oligocene boundary, eastern Gulf Coast region: Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 89-97.

Cole, W. S., 1927, A foraminiferal fauna from the Guayabal Formation in Mexico: Am. Paleontology Bull., v. 14, no. 51, 46 p.

_____1928, A foraminiferal fauna from the Chapapote Formation in Mexico: Am. Paleontology Bull., v. 14, no. 53, 32 p.

Cooke, C. W., 1915, The age of the Ocala Limestone: U.S. Geol. Survey Prof. Paper 95, p. 107-117.

_____1918, Correlation of the deposits of Jackson and Vicksburg ages in Mississippi and Alabama: Wash. Acad. Sci. Jour., v. 8, p. 186-198.

_____1923, The correlation of the Vicksburg Group: U.S. Geol. Survey Prof. Paper 133, p. 1-9.

_____1925, Correlation of the Eocene formations in Mississippi and Alabama: U.S. Geol. Survey Prof. Paper 140, p. 133-136.

_____1926, Geology of Alabama; the Cenozoic formations: Alabama Geol. Survey Spec. Rept. 14, p. 251-297.

_____1935, Notes on the Vicksburg Group: Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1162-1172.

Cooke, C. W., 1945, Geology of Florida: Florida Geol. Survey Bull. 29, 339 p.

Cooke, C. W., Gardner, J. A., and Woodring, W. P., 1943, Correlation of the Cenozoic formations of the Atlantic and Gulf Coastal Plain and the Caribbean region: Geol. Soc. America Bull., v. 54, no. 11, p. 1713-1723.

Cushman, J. A., 1920, Some relationships of the foraminiferal fauna of the Byram calcareous marl [Hinds County, Mississippi]: Washington Acad. Sci. Jour., v. 10, no. 7, p. 198-201.

_____1922a, The Foraminifera of the Byram calcareous marl at Byram, Mississippi: U.S. Geol. Survey Prof. Paper 129, p. 87-122.

_____1922b, The Foraminifera of the Mint Spring calcareous marl member of the Marianna Limestone: U.S. Geol. Survey Prof. Paper 129, p. 123-152.

_____1923, The Foraminifera of the Vicksburg Group: U.S. Geol. Survey Prof. Paper 133, p. 11-67.

_____1925, Eocene Foraminifera from the Cocoa Sand of Alabama: Cushman Lab. Foram. Research Contr., v. 1, pt. 3, p. 65-69.

_____1926, Some new Foraminifera from the upper Eocene of the southeastern Coastal Plain of the United States: Cushman Lab. Foram. Research Contr., v. 2, pt. 2, p. 29-36.

_____1929, Notes on the Foraminifera of the Byram marl: Cushman Lab. Foram. Research Contr., v. 5, pt. 2, p. 40-48.

_____1933, New Foraminifera from the upper Jackson Eocene of the southeastern Coastal Plain region of the United States: Cushman Lab. Foram. Research Contr., v. 9, pt. 1, p. 1-21.

_____1935a, Upper Eocene Foraminifera of the southeastern United States: U.S. Geol. Survey Prof. Paper 181, 88 p.

_____1935b, New species of Foraminifera from the lower Oligocene of Mississippi: Cushman Lab. Foram. Research Contr., v. 11, pt. 2, p. 25-39.

_____1939, Eocene Foraminifera from submarine cores off the eastern coast of North America: Cushman Lab. Foram. Research Contr., v. 15, pt. 3, p. 49-76.

_____1946, A rich foraminiferal fauna from the Cocoa Sand of Alabama: Cushman Lab. Foram. Research Spec. Pub. 16, 40 p.

Cushman, J. A., and Applin, E. R., 1926, Texas Jackson Foraminifera: Am. Assoc. Petroleum Geologists Bull., v. 10, no. 2, p. 154-189.

Cushman, J. A., and McGlamery, Winnie, 1938, Oligocene Foraminifera from Choctaw Bluff, Alabama: U.S. Geol. Survey Prof. Paper 189-D, p. 103-119.

_____1939, New species of Foraminifera from the lower Oligocene of Alabama: Cushman Lab. Foram. Research Contr., v. 15, pt. 3, p. 45-49.

_____1942, Oligocene Foraminifera near Millry, Alabama: U.S. Geol. Survey Prof. Paper 197-B, p. 65-84.

Cushman, J. A., and Ozawa, Yoshiaki, 1930, A monograph of the foraminiferal family Polymorphinidae, recent and fossil: U.S. Natl. Mus. Proc., v. 77, art. 6, 195 p.

Cushman, J. A., and Todd, M. R., 1945, Foraminifera of the type locality of the Moodys Marl Member of the Jackson Formation of Mississippi: Cushman Lab. Foram. Research Contr., v. 21, pt. 4, p. 79-105.

_____1946, A foraminiferal fauna from the Byram marl at its type locality: Cushman Lab. Foram. Research Contr., v. 22, pt. 3, p. 76-102.

Cushman, J. A., and Todd, M. R., 1948, Foraminifera from the Red Bluff-Yazoo section, Red Bluff, Mississippi: Cushman Lab. Foram. Research Contr., v. 24, pt. 1, p. 1-12.

Eames, F. E., Banner, F. T., Blow, W. H., and Clarke, W. J., 1962, Fundamentals of mid-Tertiary stratigraphical correlation: Cambridge [England] Univ. Press, 163 p.

Echols, Dorothy J., and Schaeffer, Katherine M. M., 1960, Microforaminifera of the Marianna Limestone (Oligocene), from Little Stave Creek, Alabama: Micropaleontology, v. 6, no. 4, p. 399-415.

Finlay, H. J., 1947, New Zealand Foraminifera, key species in stratigraphy: New Zealand Jour. Sci. and Technol., v. 28, no. 5, p. 259-292.

Gardner, Julia, 1957, Little Stave Creek, Alabama—paleoecologic study *of* Ladd, H. S., ed., Paleoecology: Geol. Soc. America Mem. 67, p. 573-588.

Gooch, D. D., 1939, Some Ostracoda of the genus *Cythereis* from the Cook Mountain Eocene of Louisiana: Jour. Paleontology, v. 13, no. 6, p. 580-588.

Gravell, D. W., and Hanna, M. A., 1938, Subsurface Tertiary zones of correlation through Mississippi, Alabama, and Florida: Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 984-1013.

Hendy, W. J., 1948, Notes on the stratigraphy of northeastern Wayne County, Mississippi, *in* Mississippi Geol. Soc. Guidebook, 6th Field Trip: p. 25-31.

Hilgard, E. W., 1860, Report on the geology and agriculture of the State of Mississippi: Jackson, Miss., 391 p.

Holland, W. C., Hough, L. W., and Murray, G. E., 1952, Geology of Beauregard and Allen Parishes: Louisiana Geol. Survey Bull. 27, 224 p.

Hornibrook, N. de B, 1958, New Zealand Upper Cretaceous and Tertiary foraminiferal zones and some overseas correlations: Micropaleontology, v. 4, no. 1, p. 25-38.

Howe, H. V. W., 1928a, An observation on the range of the genus *Hantkenina*: Jour. Paleontology, v. 2, no. 1, p. 13-14.

_____1928b, Additions to the list of species occurring in the type Red Bluff Clay, Hiwannee, Mississippi: Jour. Paleontology, v. 2, no. 3, p. 173-176.

_____1930a, The genus *Bolivinella* in the Oligocene of Mississippi: Jour. Paleontology, v. 4, no. 3, p. 263-267.

_____1930b, Distinctive new species of Foraminifera from the Oligocene of Mississippi: Jour. Paleontology, v. 4, no. 4, p. 327-331.

_____1933, Review of Tertiary stratigraphy of Louisiana: Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 613-655.

_____1936, Ostracoda of the genus *Eucythere* from the Tertiary of Mississippi: Jour. Paleontology, v. 10, no. 2, p. 143-145.

_____1942, Fauna of the Glendon Formation at its type locality [Alabama]: Jour. Paleontology, v. 16, no. 2, p. 264-271.

_____1962, Ostracod taxonomy: Baton Rouge, La., Louisiana State Univ. Press, 366 p.

Howe, H. V. W., and Chambers, Jack, 1935, Louisiana Jackson Eocene Ostracoda: Louisiana Dept. Cons., Geol. Bull. 5, 65 p.

Howe, H. V. W., and Law, John, 1936, Louisiana Vicksburg Oligocene Ostracoda: Louisiana Dept. Cons., Geol. Bull. 7, 96 p.

Howe, H. V. W., and Wallace, W. E., 1932, Foraminifera of the Jackson Eocene at Danville Landing, on the Ouachita, Catahoula Parish, Louisiana: Louisiana Dept. Cons., Geol. Bull. 2, 118 p.

_____1934, Apertural characteristics of the genus *Hantkenina* with description of a new species: Jour. Paleontology, v. 8, no. 1, p. 35-37.

Ivey, John B., 1957, Geology and ground water in the Monroeville area, Alabama: Alabama Geol. Survey Bull. 66, 116 p.

Keij, A. J., 1957, Eocene and Oligocene Ostracoda of Belgium: Inst. royal Sci. Nat. Belgique Mem. 136, 210 p.

Krutak, Paul R., 1961, Jackson Eocene Ostracoda from the Cocoa Sand of Alabama: Jour. Paleontology, v. 35, no. 4, p. 769-788.

Loeblich, A. R., Jr., and Tappan, Helen, 1961a, Suprageneric classification of the Rhizopodea: Jour. Paleontology, v. 35, no. 2, p. 245-330.

_____1961b, Remarks on the systematics of Sarkodina (Protozoa), renamed homonyms and new and validated genera: Washington Bio. Soc. Proc., v. 74, p. 213-234.

Lowman, S. W., 1949, Sedimentary facies in Gulf Coast: Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 1939-1997.

MacNeil, F. S., 1944, Oligocene stratigraphy of southeastern United States: Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1313-1354.

_____1946, Geologic map of the Tertiary formations of Alabama: U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 45.

_____1947, Correlation chart for the outcropping Tertiary formations of the eastern Gulf region: U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29.

Maury, Carlotta J., 1902, A comparison of the Oligocene of western Europe and the southern United States: Am. Paleontology Bull., v. 3, no. 15, p. 311-404.

McGlothlin, Tom, 1944, General geology of Mississippi: Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 29-62.

Mississippi Geological Society, 1945, Tertiary correlation chart, Mississippi: Jackson, Mississippi Geol. Soc.

Monroe, W. H., 1947, Geologic map of the Jackson area, Mississippi: U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 65.

Monsour, Emil, 1937, Micropaleontologic analysis of Jackson Eocene of eastern Mississippi: Am. Assoc. Petroleum Geologists Bull., v. 21, no. 1, p. 80-96.

Monsour, E. T., 1948, Generalized stratigraphic discussion of post-Claiborne sediments in Mississippi and correlation with equivalent age sediments in the Gulf Coast province *in* Mississippi Geol. Soc. Guidebook, 6th Field Trip: p. 3-16.

Moore, R. C., ed., 1961, Treatise on invertebrate paleontology, Arthropoda 3, pt. Q: Kansas Univ. Press and Geol. Soc. America, 442 p.

Moore, W. E., 1955, Geology of Jackson County, Florida: Florida Geol. Survey Bull. 37, 101 p.

Mornhinveg, A. R., 1941, The Foraminifera of Red Bluff [Mississippi]: Jour. Paleontology, v. 15, no. 4, p. 431-435.

Murray, G. E., 1947, Cenozoic deposits of central Gulf Coastal Plain: Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1825-1850.

_____1950, Lithologic facies of Jacksonian Stage, central and eastern Gulf Coast [abs.]: Oil and Gas Jour., v. 48, no. 51, p. 123, 172.

Murray, G. E., 1952a, Vicksburg Stage and Mosley Hill Formation [Gulf Coastal Plain]: Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700-707.

_____1952b, Volume of Mesozoic and Cenozoic sediments in central Gulf Coastal Plain of United States, pt. 3 *of* Murray, G. E., Sedimentary volumes in Gulf Coastal Plain of the United States and Mexico: Geol. Soc. America Bull., v. 63, no. 12, pt. 1, p. 1177-1191.

_____1961, Geology of the Atlantic and Gulf Coastal province of North America: New York, Harper and Brothers, 692 p.

Murray, G. E., and Wilbert, L. J., 1950, Jacksonian Stage: Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1990-1997.

Pokorný, Vladimír, 1958, Grundzüge der Zoologischen Mikropaläontologie Bd. II: Berlin, Deutsch. Verlag Wiss., 453 p.

Simpson, G. G., 1947, Holarctic mammalian faunas and continental relationships during the Cenozoic: Geol. Soc. America Bull., v. 58, no. 7, p. 613-687.

_____1960, Notes on the measurement of faunal resemblance: Am. Jour. Sci., v. 258-A (Bradley volume), p. 300-311.

Smith, R. H., Osanik, A., Hendy, W., Wilbert, L. J., Wasem, R., Monsour, E., Thomas, P., and Murray, G. E., 1944, Little Stave Creek, Clarke County, Ala., *in* Southeastern Geol. Soc. Guidebook 1st Field Trip: Stratigraphic section.

Spraul, G. L., 1962, Current status of the upper Eocene foraminiferal guide fossil, *Cribrohantkenina*: Gulf Coast Assoc. Geol. Soc. Trans., v. 12, p. 343-347.

_____1963, Current status of the upper Eocene foraminiferal guide fossil, *Cribrohantkenina*: Jour. Paleontology, v. 37, no. 2, p. 366-370.

Stainforth, R. M., 1952a, Classification of uniserial calcareous Foraminifera: Cushman Found. Foram. Research Contr., v. 3, pt. 1, p. 6-14.

_____1952b, *Nodosaria* nomenclature: Cushman Found. Foram. Research Contr., v. 3, pts. 3-4, p. 146.

Stuckey, C. W., Jr., 1960, A correlation of the Gulf Coast Jackson: Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 285-298.

Thalmann, H. E., 1942, Foraminiferal genus *Hantkenina* and its subgenera: Am. Jour. Sci., v. 240, no. 11, p. 809-820.

Toulmin, L. D., 1940, The Salt Mountain Limestone of Alabama: Alabama Geol. Survey Bull. 46, 126 p.

_____1944, General features of the Tertiary formations in Alabama, *in* Southeastern Geol. Soc. Guidebook 1st Field Trip: p. 5-15.

_____1952, Volume of Cenozoic sediments in Florida and Georgia, pt. 2 *of* Murray, G. E., Sedimentary volumes in Gulf Coastal Plain of the United States and Mexico: Geol. Soc. America Bull., v. 63, no. 12, p. 1165-1175.

_____1955, Cenozoic geology of southeastern Alabama, Florida, and Georgia: Am. Assoc. Petroleum Geologists Bull., v. 39, no. 2, p. 207-235.

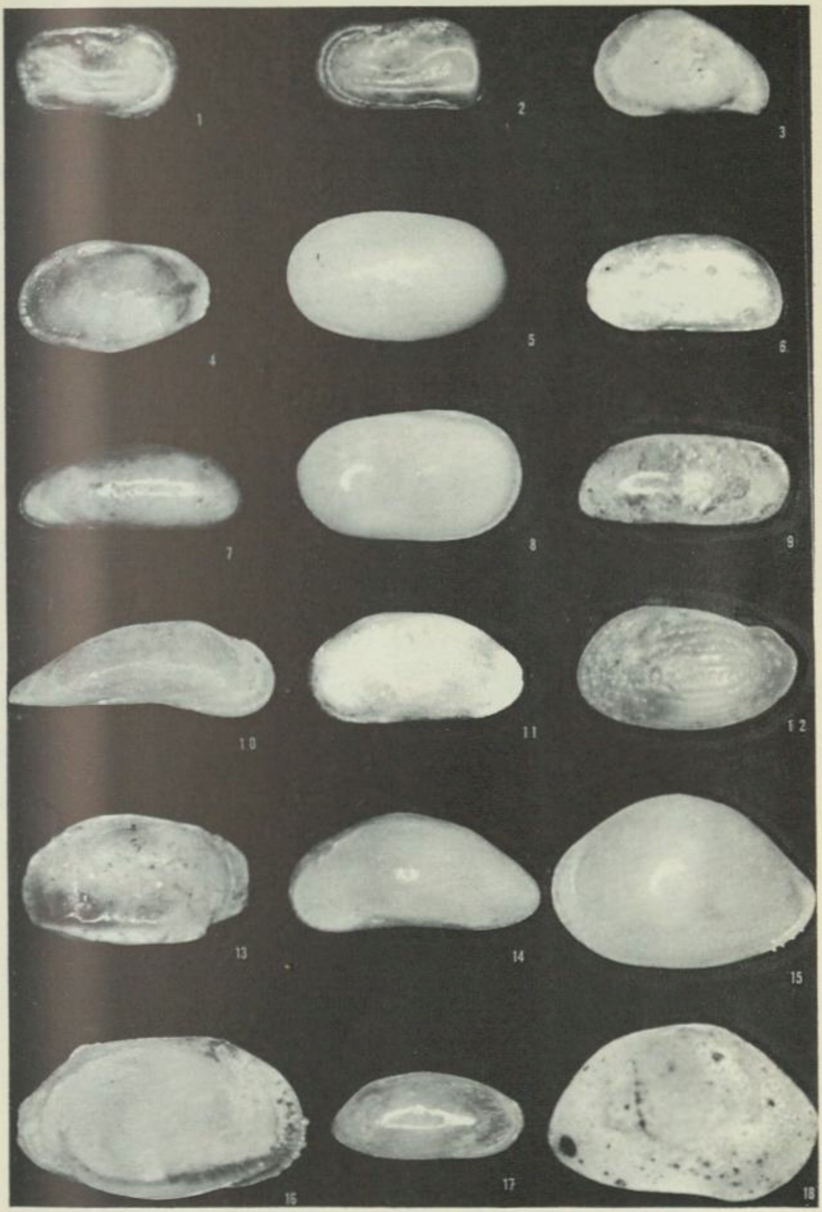
Triebel, Erich, 1940, Die Ostracoden der deutschen Kreide; 3, Cytherideinae und Cytherinae aus der unteren Kreide: Senckenbergiana (Senckenb. Naturf. Ges.) Bd. 22, no. 3-4, p. 160-227.

PLATES 11 - 28

PLATE 11

Figure 1, 2. *Cytherelloidea cocoaensis* Krutak; male RV (fig. 1), female LV (fig. 2), X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 13

3. *Eucythere woodwardensis* Howe; LV, X 40; Pachuta Marl Member of Yazoo Clay at locality 2, sample 6
4. *Digmocythere watervalleyensis* (Howe and Chambers); LV, X 40; Cocoa Sand Member of Yazoo Clay at locality 5, sample 13
5. *Cytherella* sp. 1; LV, X 40; Marianna Limestone at locality 3, sample 2
6. *Krithe* n. sp. 1; LV, X 40; Red Bluff Clay at locality 4, sample 4
7. *Cushmanidea* n. sp. 1; RV, X 40; Pachuta Marl Member of Yazoo Clay at locality 5, sample 12
8. *Cytherella* sp. 1; RV, X 40; Marianna Limestone at locality 3, sample 2
9. *Krithe hiwanneensis* Howe and Lea; RV, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13
10. *Paracypris rosefieldensis* Howe and Law; RV, X 32; Red Bluff Clay at locality 2, sample 6
11. *Propontocypris mississippiensis* (Howe and Law); LV, X 32; Red Bluff Clay at locality 5, sample 4
12. *Cytheretta jacksonensis* (Meyer); LV, X 32; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17
13. *Pterygocythereis murrayi* (Hill); LV, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 11
14. *Bythocypris gibsonensis* Howe and Chambers; LV, X 32; Red Bluff Clay at locality 2, sample 5
15. *Bairdia* sp. 1; LV, X 32; Shubuta Member of Yazoo Clay at locality 5, sample 11
16. *Digmocythere russelli* (Howe and Lea); RV, X 32; Shubuta Member of Yazoo Clay at locality 1, sample 12
17. *Argilloecia hiwanneensis* Howe and Law; RV, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 12
18. *Bairdoppilata ocalana* (Puri); RV, X 32; Pachuta Marl Member of Yazoo Clay at locality 5, sample 12



ARGILLOECIA, BAIRDIA, BAIRDOPPILATA, BYTHOCYPRIS, CUSHMANIDEA, CYTHERELLA, CYTHERELLOIDEA, CYTHERETTA, DIGMOCYTHERE, EUCYTHERE, KRITHE, PARACYPRIS, PROPONTOCYPRIS, PTERYGOCYTHEREIS

PLATE 12

Figure 1. *Buntonia* n. sp. 1; female LV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

2. *Occultocythereis broussardi* (Howe and Chambers); LV, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

3. *Paracytheridea belhavenensis* Howe and Chambers; RV, X 40; Pachuta Marl Member of Yazoo Clay at locality 7, sample 8

4. *Buntonia* n. sp. 1; male RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

5. *Cytheropteron danvillensis* Howe and Chambers; LV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

6. *Paracytheridea woodwardensis* Howe and Law; LV, X 40; Marianna Limestone at locality 4, sample 1

7. *Buntonia israelskyi* (Howe and Pyeatt); RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

8. *Loxoconcha concentrica* Krutak; RV, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 10

9. *Loxoconcha creolensis* Howe and Chambers; RV, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 13

10. *Ambocythere* n. sp. 1; RV, X 40; Marianna Limestone at locality 5, sample 1

11. *Konarocythere spurgeonae* (Howe and Chambers); LV, X 40; locality 4, sample 13

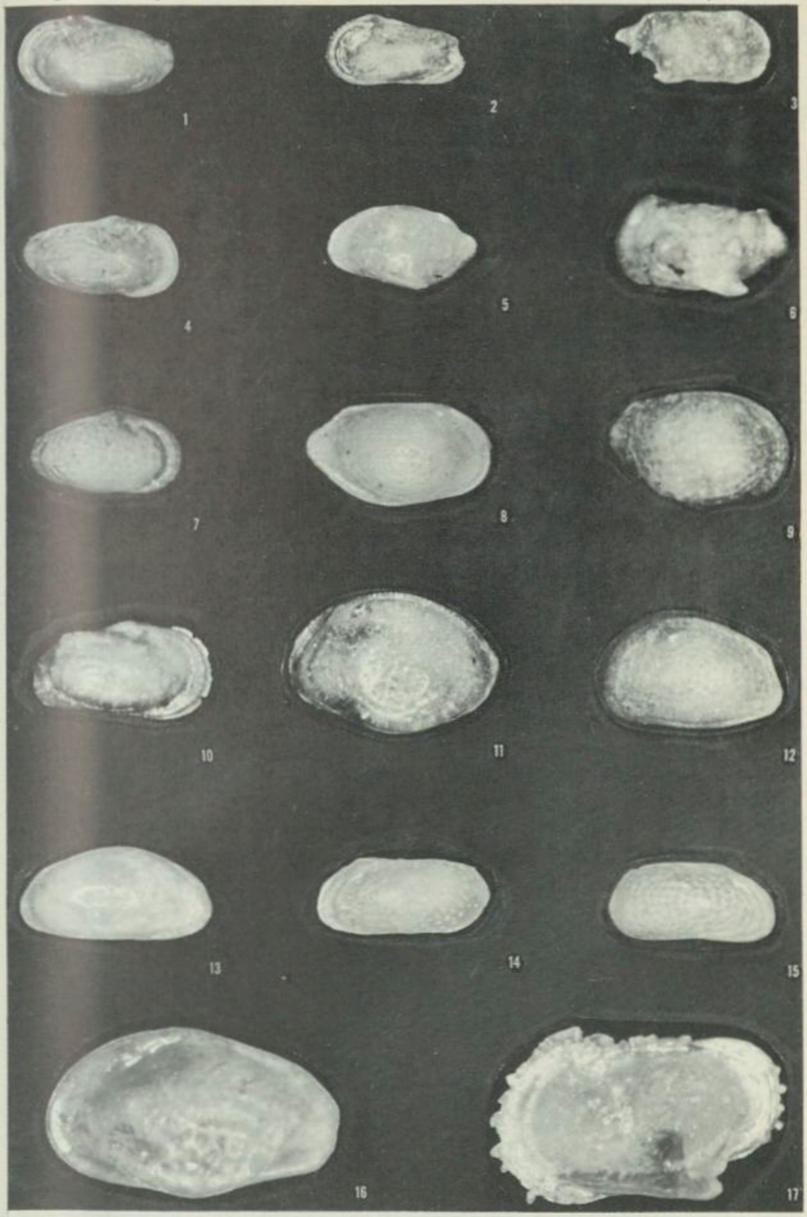
12. *Hemicythere kniffeni* Howe and Law; LV, X 40; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3

13. *Cyamocytheridea watervalleyensis* (Stephenson); RV, X 40; Cocoa Sand Member of Yazoo Clay at locality 5, sample 13

14, 15. *Triginglymus* n. sp. 1; RV (fig. 14), LV (fig. 15), X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

16. *Brachycythere mississippiensis* (Meyer); LV, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

17. *Pterygocythereis ivani* (Howe and Law); LV, X 40; Red Bluff Clay at locality 2, sample 6



AMBOCYTHERE, BRACHYCYTHERE, BUNTONIA, CYAMOCYTHERIDEA, CYTHEROPTERON, HEMICYTHERE, KONAROCYTHERE, LOXOCONCHA, OCCULTOCYTHEREIS, PARACYTHERIDEA, PTERYGOCYTHEREIS, TRIGINGLYMUS

PLATE 13

Figure 1. *Haplocytheridea montgomeryensis* (Howe and Chambers); RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

2. *Haplocytheridea* n. sp. 1; RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 15

3. *Haplocytheridea ehlersi* (Howe and Stephenson); RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

4. *Clithrocytheridea grigsbyi* (Howe and Chambers); LV, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

5. *Clithrocytheridea garretti* (Howe and Chambers); RV, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

6. *Clithrocytheridea caldwellensis* (Howe and Chambers); LV, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12

7. *Isocythereis couleycreekensis* (Gooch); LV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14

8, 9. *Henryhowella florienensis* (Howe and Chambers); RV (fig. 8), LV, (fig. 9), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

10. *Trachyleberidea blanpiedi* (Howe); LV, X 40; Red Bluff Clay at locality 2, sample 6

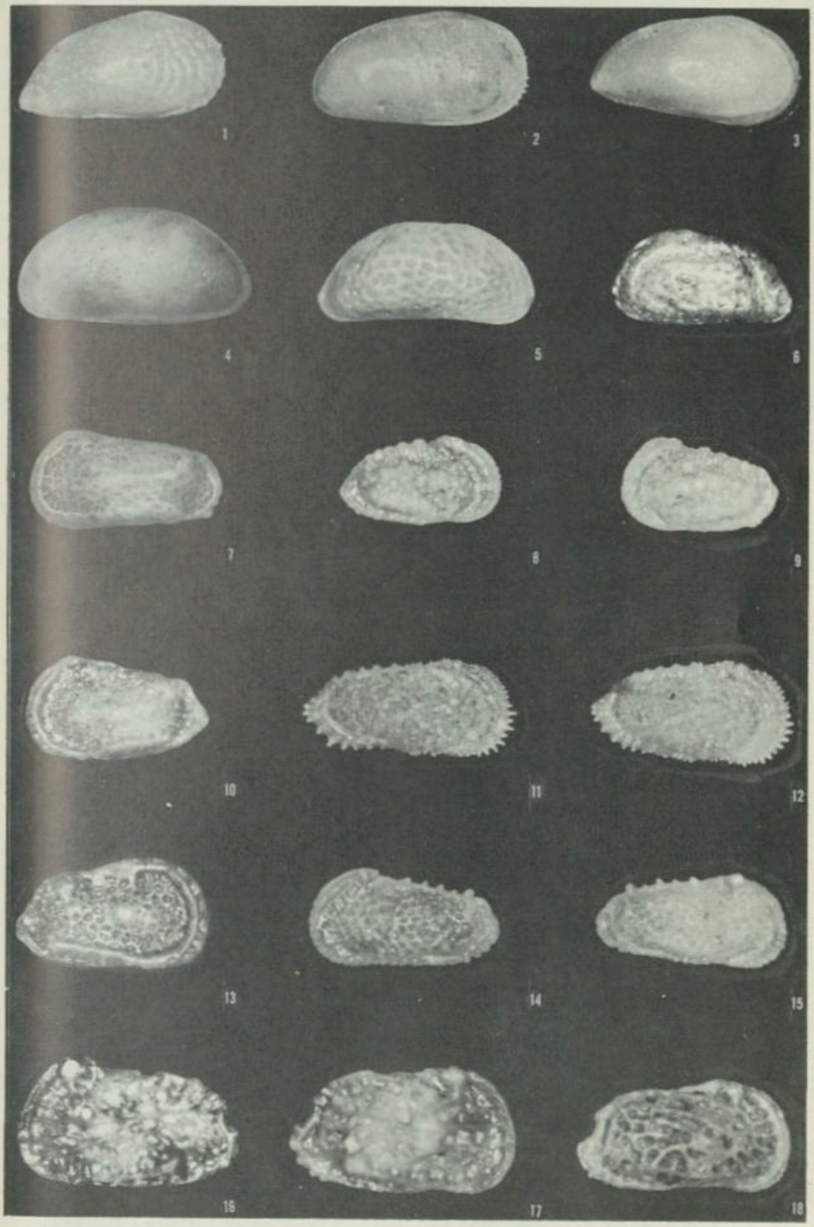
11, 12. *Henryhowella florienensis* (Howe and Chambers); male LV (fig. 11), female LV (fig. 12), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

13. *Trachyleberidea blanpiedi* (Howe); RV, X 40; Red Bluff Clay at locality 2, sample 6

14, 15. N. Gen. n. sp. 1; LV (fig. 14), RV (fig. 15), X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

16, 17. *Jugosocythereis bicarinata* (Swain); LV (fig. 16), RV (fig. 17), X 40; Cocoa Sand Member of Yazoo Clay at locality 5, sample 13

18. *Jugosocythereis vicksburgensis* (Howe and Law); RV, X 40; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3



CLITHROCYTHERIDEA, HAPLOCYTHERIDEA, HENRYHOWELLA, ISOCYTHEREIS, JUGOSOCYTHEREIS, N. GEN., *TRACHYLEBERIDEA*

PLATE 14

Figure 1. *"Cythereis" dohmi* Howe and Chambers; RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

2, 3. *"Cythereis" hysonensis* Howe and Chambers; LV (fig. 2), RV (fig. 3), X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

4, 5. *Actinocythereis dacyi* (Howe and Law); male LV (fig. 4), female LV (fig. 5), X 40; Red Bluff Clay at locality 2, sample 6

6. *Actinocythereis gibsonensis* (Howe and Chambers); RV, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

7. *Actinocythereis* n. sp. 1; RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 15

8. *Actinocythereis* n. sp. 2; RV, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

9, 10. *Trachyleberis montgomeryensis* (Howe and Chambers); male RV (fig. 9), female LV (fig. 10), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

11, 12. *Trachyleberis* n. sp. 1; male RV (fig. 11), female RV (fig. 12), X 40; Shubuta Member of Yazoo Clay at locality 2, sample 9

13. *Trachyleberis montgomeryensis* (Howe and Chambers); female LV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

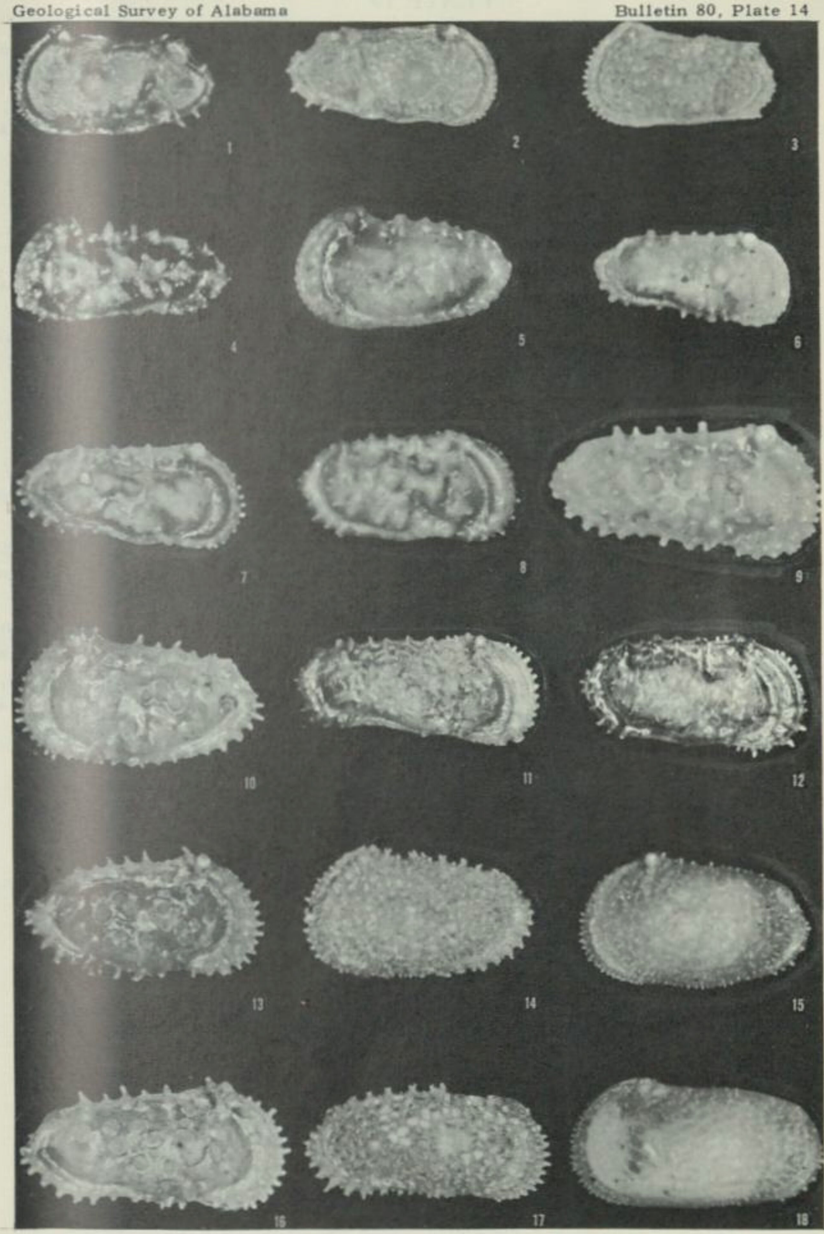
14. *Acanthocythereis* n. sp. 1; female RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

15. *Echinocythereis mcguirti* (Howe); LV, X 40; Red Bluff Clay at locality 2, sample 7

16. *Trachyleberis* n. sp. 2; male RV, X 40; Red Bluff Clay at locality 4, sample 6

17. *Acanthocythereis* n. sp. 1; male RV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

18. *Echinocythereis jacksonensis* (Howe and Pyeatt); male LV, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13



ACANTHOCYTHEREIS, ACTINOCYTHEREIS, "CYTHEREIS", ECHINOCYTHEREIS, TRACHYLEBERIS

PLATE 15

Figure 1, 2, 3. *Pseudohastigerina micra* (Cole); peripheral view (fig. 1), side views (figs. 2, 3), X 80; Shubuta Member of Yazoo Clay at locality 1, sample 12

4. *Cribrohantkenina inflata* (Howe); peripheral view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

5. *Hantkenina alabamensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

6. *Cribrohantkenina inflata* (Howe); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

7, 8. *Hantkenina alabamensis* Cushman; side views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

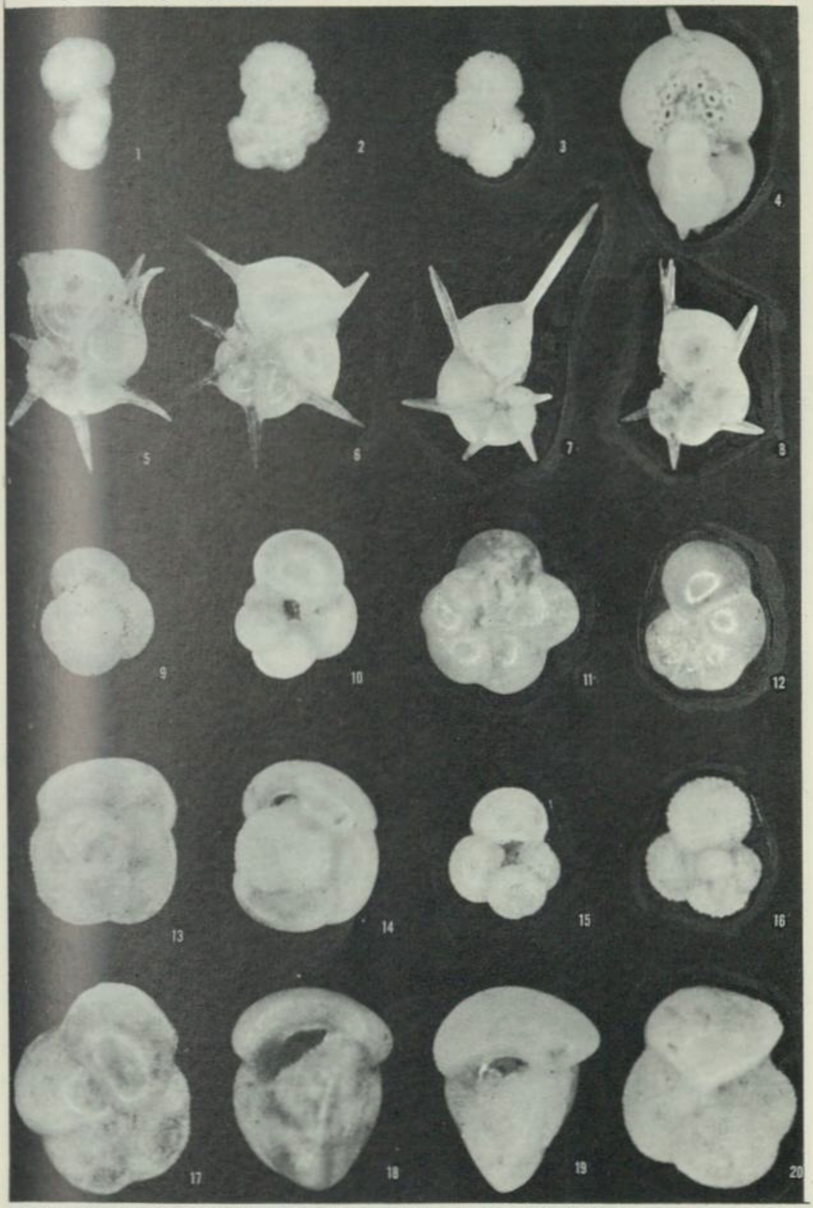
9, 10. *Globorotalia increbescens* (Bandy); dorsal view (fig. 9), ventral view (fig. 10), X 60; Shubuta Member of Yazoo Clay at locality 1, sample 12

11, 12. *Hastigerina danvillensis* (Howe); side views, X 60; Shubuta Member of Yazoo Clay at locality 1, sample 10

13, 14. *Globorotalia cerroazulensis* (Cole); dorsal views of keeled (fig. 13) and unkeeled (fig. 14) forms, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

15, 16. *Globigerina ouachitaensis* Howe and Wallace; ventral view (fig. 15), dorsal view (fig. 16), X 80; Shubuta Member of Yazoo Clay at locality 5, sample 9

17-20. *Globorotalia cerroazulensis* (Cole); ventral view of keeled form (fig. 17), peripheral view of keeled form (fig. 18), peripheral view of unkeeled form (fig. 19), ventral view of unkeeled form (fig. 20), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14



CRIBROHANTKENINA, GLOBIGERINA, GLOBOROTALIA, HANTKENINA, HASTIGERINA, PSEUDOHASTIGERINA

PLATE 16

Figure 1-3. *Globorotalia centralis* Cushman and Bermudez; dorsal view (fig. 1), peripheral view (fig. 2), ventral view (fig. 3), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 9

4, 5. *Globigerinita dissimilis* (Cushman and Bermudez); ventral views, X 40; Marianna Limestone at locality 3, sample 2

6. *Globigerina ampliapertura* Bolli; ventral view, X 40; Red Bluff Clay at locality 2, sample 5

7, 8. *Globigerina pseudoampliapertura* Blow and Banner; dorsal view (fig. 7), ventral view (fig. 8), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 11

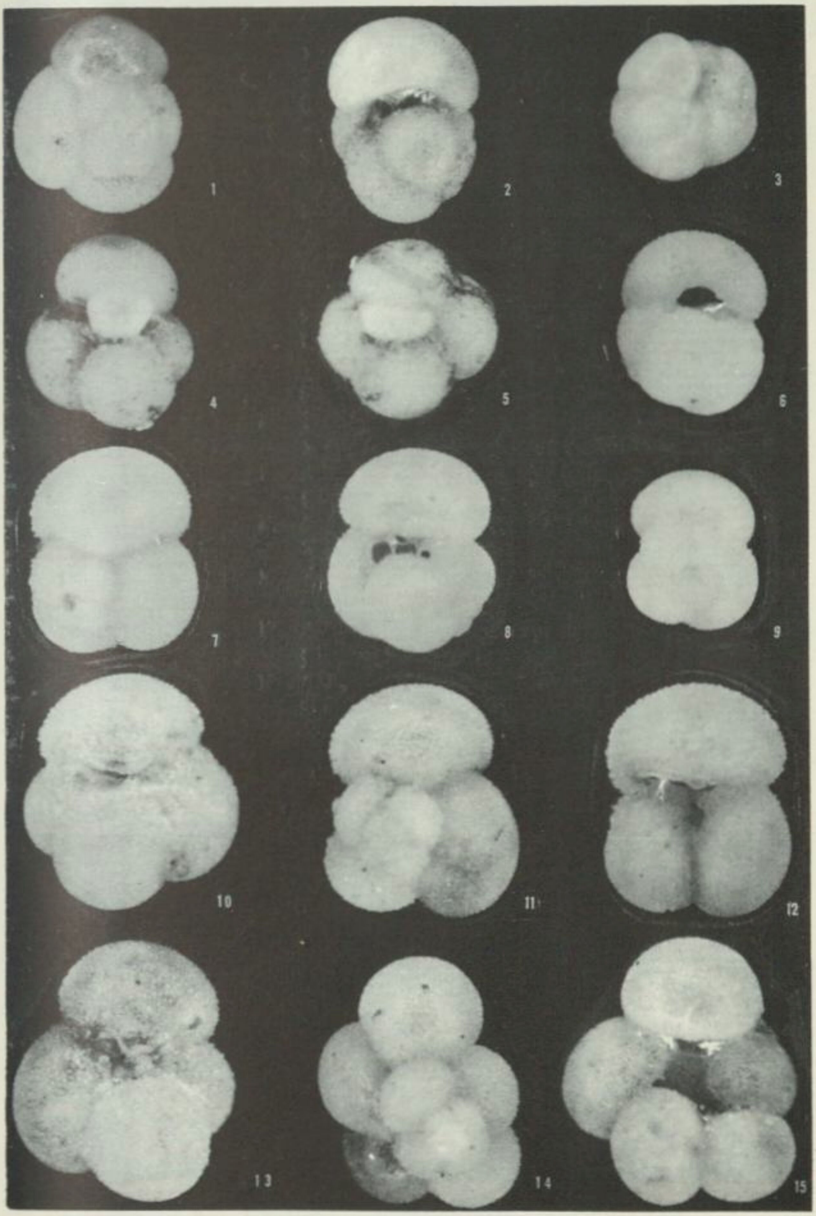
9. *Globigerina ampliapertura* Bolli; dorsal view, X 40; Red Bluff Clay at locality 2, sample 5

10. *Globigerina yeguaensis pseudovenezuelana* Blow and Banner; ventral view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

11, 12. *Globigerina tripartita tripartita* Koch; dorsal view (fig. 11), ventral view (fig. 12), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

13. *Globigerina yeguaensis pseudovenezuelana* Blow and Banner; ventral view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

14, 15. *Globigerina* n. sp. 1; dorsal view (fig. 14), ventral view (fig. 15), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13



GLOBIGERINA, GLOBIGERINITA, GLOBOROTALIA

PLATE 17

Figure 1. *Globigerina yeguaensis pseudovenezuelana* Blow and Banner; dorsal view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

2, 3. *Globigerinita pera* (Todd); ventral views, X 40; Shubuta Member of Yazoo Clay at locality 5, sample 9

4. *Globigerina yeguaensis yeguaensis* Weinzierl and Applin; dorsal view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

5. *Globigerinita pera* (Todd); ventral view, X 40; Shubuta Member of Yazoo Clay at locality 5, sample 9

6, 7. *Globigerina yeguaensis yeguaensis* Weinzierl and Applin; ventral views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

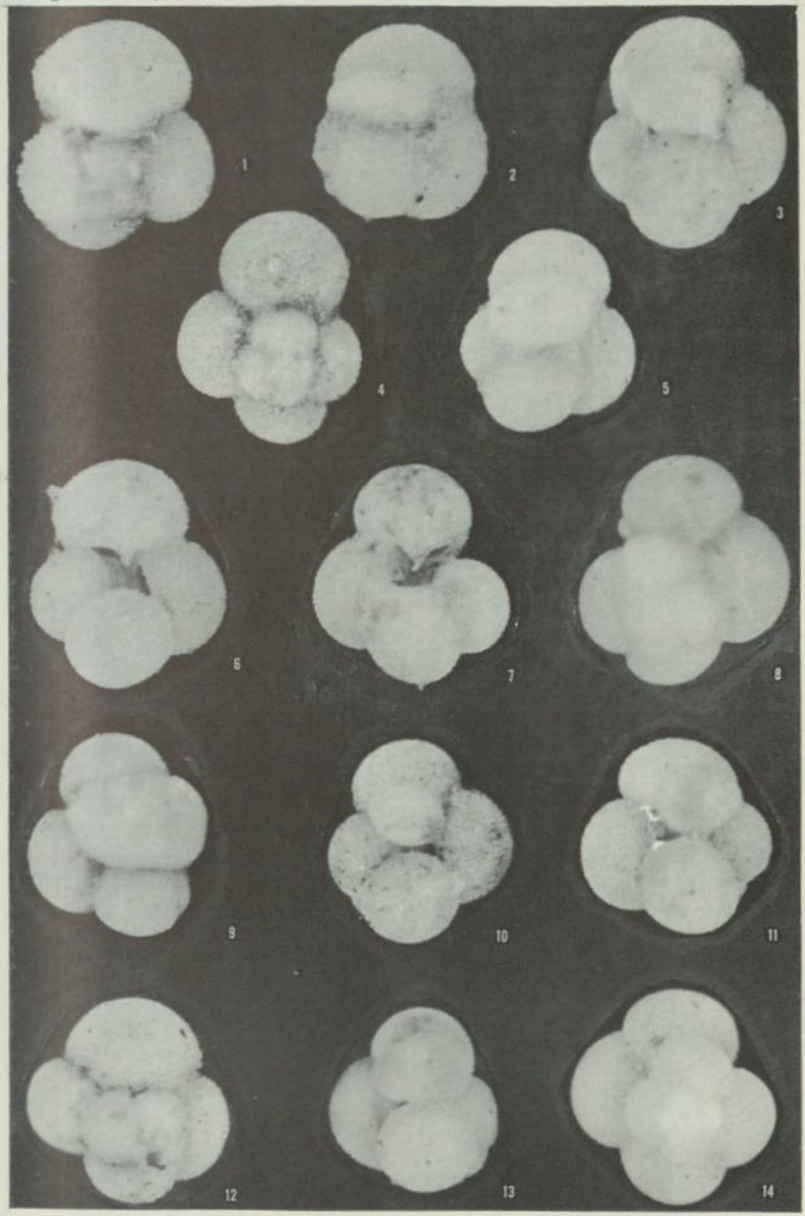
8. *Globigerinita pera* (Todd); dorsal view, X 40; Shubuta Member of Yazoo Clay at locality 5, sample 9

9. *Globigerina turritilina praeturritilina* Blow and Banner; ventral view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

10, 11. *Globigerina gortanii* (Borsetti); ventral views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 8

12. *Globigerina turritilina praeturritilina* Blow and Banner; dorsal view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

13, 14. *Globigerina gortanii* (Borsetti); ventral view (fig. 13), dorsal view (fig. 14), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 8



GLOBIGERINA, GLOBIGERINITA

PLATE 18

Figure 1. *Spiroplectammina alabamensis* (Cushman); side view, X 40; Red Bluff Clay at locality 4, sample 6

2. *Spiroplectammina mississippiensis* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 11
3. *Spiroplectammina alabamensis* (Cushman); side view, X 40; Red Bluff Clay at locality 4, sample 6
4. *Textularia conica* D'Orbigny; side view, X 40; Marianna Limestone at locality 4, sample 2
5. *Textularia* sp. 1; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12
6. *Textularia recta* Cushman; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 13
7. *Textularia tumidulum* Cushman; side view, X 40; Marianna Limestone at locality 3, sample 1
8. *Textularia hauerii* Cushman; side view, X 24; Red Bluff Clay at locality 2, sample 4
9. *Textularia* sp. 3; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16
10. *Spiroplectammina mississippiensis* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 10
11. *Liebusella byramensis* (Cushman); side view, X 24; Shubuta Member of Yazoo Clay at locality 1, sample 10
12. *Liebusella byramensis turgida* (Cushman); side view, X 24; Red Bluff Clay at locality 4, sample 4
13. *Textularia porrecta* Brady; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16
14. *Textularia adalta* Cushman; side view, X 24; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17
15. *Textularia dibollensis* Cushman and Applin; side view, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17
16. *Pseudogaudryina jacksonensis* Cushman; side view, X 24; Shubuta Member of Yazoo Clay at locality 1, sample 13
17. *Pseudogaudryina* sp. 1; side view, X 24; Shubuta Member of Yazoo Clay at locality 4, sample 7
18. *Karreriella advena* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12
19. *Textularia subhauerii* Cushman; side view, X 24; Marianna Limestone at locality 3, sample 2
20. *Textularia* sp. 2; side view, X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

KARRERIELLA, LIEBUSELLA, PSEUDOGAUDRYINA, SPIROPLECTAMMINA, TEXTULARIA

PLATE 19

Figure 1, 2. *Cyclammina* sp. 1; side view, X 40; Red Bluff Clay at locality 2, sample 6

3. *Ammobaculites subagglutinans* Bandy; side view, X 40; Marianna Limestone at locality 4, sample 2

4. *Pseudoclavulina cocoaensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

5. *Vulvulina advena* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

6, 7. *Massilina decorata* Cushman; side views, X 60; Red Bluff Clay at locality 4, sample 6

8. *Spiroloculina* sp. 1; side view, X 60; Red Bluff Clay at locality 4, sample 6

9. *Spiroloculina occulsa* (Cushman); side view, X 60; Red Bluff Clay at locality 2, sample 6

10. *Massilina cookei* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 10

11, 12. *Guttulina spicaeformis* (Roemer); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

13. *Globulina alabamensis* Cushman and McGlamery; side view, X 40; Red Bluff Clay at locality 2, sample 4

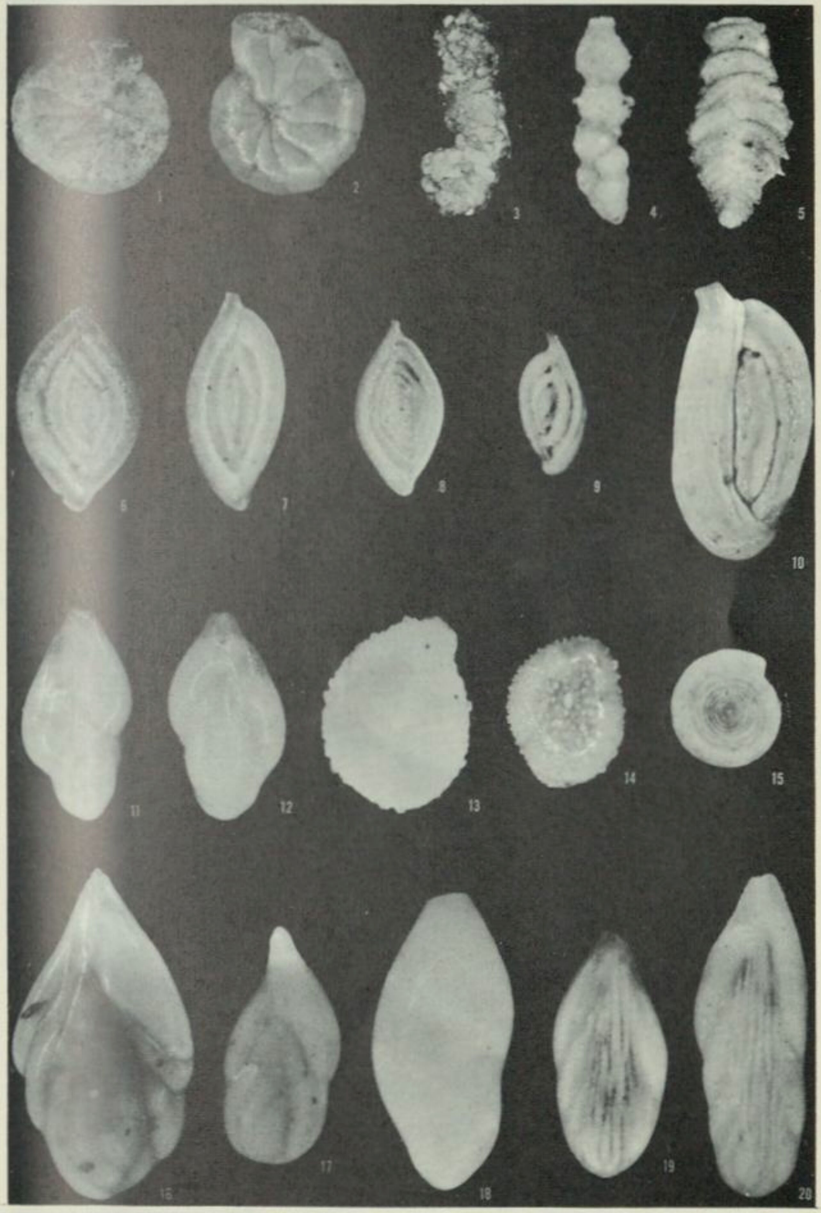
14. *Globulina inaequalis caribaea* Reuss; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

15. *Cornuspira involvens* Cushman; side view, X 40; Red Bluff Clay at locality 2, sample 6

16, 17. *Sigmomorphina jacksonensis* (Cushman); side view, X 12; Shubuta Member of Yazoo Clay at locality 1, sample 13

18. *Pyrulina* sp.; side view, X 12; Marianna Limestone at locality 3, sample 2

19, 20. *Sigmomorphina costifera* (Cushman); side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 2



AMMOBACULITES, CORNUSPIRA, CYCLAMMINA, GLOBULINA, GUTTULINA, MASSILINA, PSEUDOCLAVULINA, PYRULINA, SIGMOMORPHINA, SPIROLOCULINA, VULVULINA

PLATE 20

Figure 1. *Plectofrondicularia garretti* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

2, 3. *Lankesterina frondea* (Cushman); side views, X 60; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

4. *Flabellina lanceolata* Bandy; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

5. *Flabellina* sp. 1; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

6. *Palmula* cf. *vaughani* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

7, 8. *Palmula caelata* (Cushman); side views, X 40; Marianna Limestone at locality 4, sample 2

9. *Frondicularia tenuissima* Hantken; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

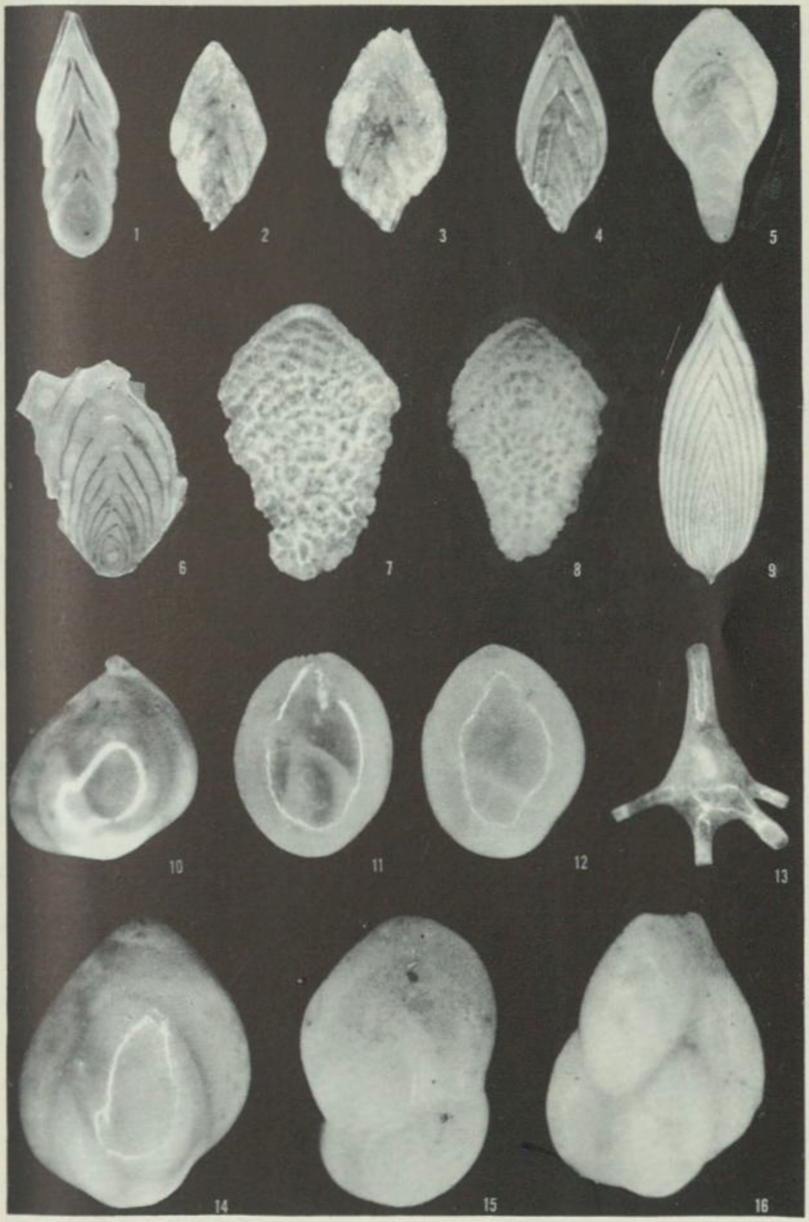
10. *Guttulina* sp. 1; side view, X 40; Marianna Limestone at locality 5, sample 2

11, 12. *Globulina gibba* d'Orbigny; side view, X 40; Marianna Limestone at locality 3, sample 2

13. *Ramulina* sp.; X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

14. *Guttulina irregularis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 11

15, 16. *Guttulina problema* Cushman; side views, X 40; Marianna Limestone at locality 5, sample 2



FLABELLINA, FRONDICULARIA, GLOBULINA, GUTTULINA, LANKESTERINA, PALMULA, PLECTOFRONDICULARIA, RAMULINA

PLATE 21

Figure 1. *Uvigerina gardnerae* Cushman; side view, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13

2, 3. *Bulimina ovata* d'Orbigny; side views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 10

4. *Uvigerina* sp. 1; side view, X 47; Cocoa Sand Member of Yazoo Clay at locality 7, sample 9

5. *Reussella byramensis* Cushman; side view, X 40; Marianna Limestone at locality 3, sample 1

6. *Uvigerina gardnerae* Cushman; side view, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13

7. *Uvigerina cocoaensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

8. *Uvigerina vicksburgensis* Cushman and Ellisor; side view, X 40; Red Bluff Clay at locality 2, sample 4

9. *Uvigerina topilensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

10. *Uvigerina jacksonensis* Cushman; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12

11. *Uvigerina glabrans* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

12. *Uvigerina cocoaensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

13. *Uvigerina* sp. 1; side view, X 47; Cocoa Sand Member of Yazoo Clay at locality 7, sample 9

14. *Uvigerina byramensis* Cushman; side view, X 40; Marianna Limestone at locality 3, sample 2

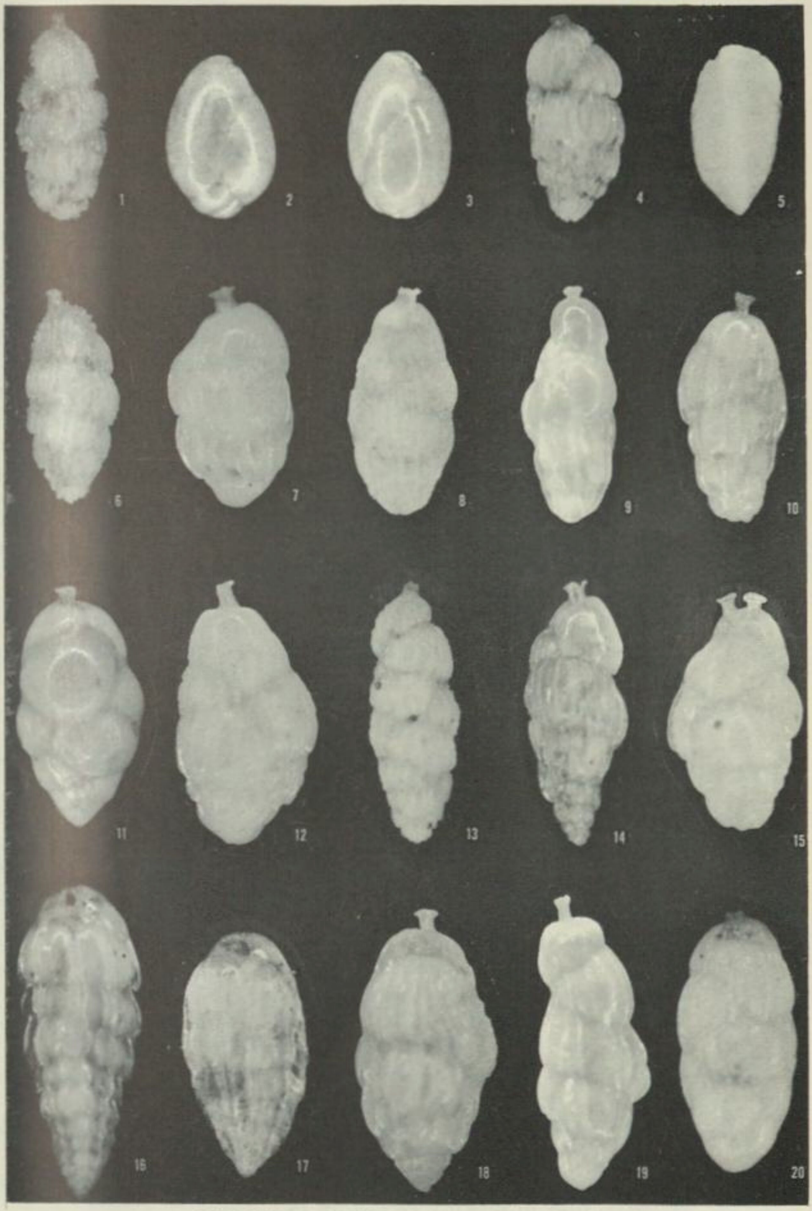
15. *Uvigerina* sp. (2 apertured); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

16, 17. *Bulimina jacksonensis* Cushman; side views, X 32; Shubuta Member of Yazoo Clay at locality 1, sample 13

18. *Uvigerina jacksonensis* Cushman; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12

19. *Uvigerina topilensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

20. *Uvigerina dumblei* Cushman and Applin; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 9



BULIMINA, REUSSELLA, UVIGERINA

PLATE 22

Figure 1, 2. *Angulogerina vicksburgensis* Cushman; side views, X 40; Red Bluff Clay at locality 4, sample 4

3. *Angulogerina danvillensis* Howe and Wallace; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

4. *Angulogerina* sp. 1; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

5. *Angulogerina byramensis* (Cushman); side view, X 40; Red Bluff Clay at locality 2, sample 7

6, 7. *Bitubulogenerina howei* Cushman; side views, X 80; Marianna Limestone at locality 6, sample 2

8. *Chiloguembelina cubensis* (Palmer); side view, X 80; Shubuta Member of Yazoo Clay at locality 1, sample 13

9. *Bolivina jacksonensis* Cushman and Applin; side view, X 60; Shubuta Member of Yazoo Clay at locality 4, sample 7

10. *Bolivina mississippiensis* Cushman; side view, X 40; Red Bluff Clay at locality 4, sample 4

11. *Bolivina dalli* (Cushman); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

12. *Loxostomum vicksburgensis* Cushman; side view, X 60; Marianna Limestone at locality 3, sample 1

13. *Bolivina gracilis* Cushman and Applin; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 10

14. *Bolivinella* sp. 1; side view, X 40; Red Bluff Clay at locality 2, sample 6

15. *Bolivinella subpectinata* Cushman; side view, X 40; Red Bluff Clay at locality 2, sample 4

16. *Bolivina taylori* Howe; side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12

17. *Bolivina alazanensis* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

18. *Bolivina* sp. 1; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

19. *Bolivina striatellata* Cushman and Applin; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

20. *Bolivina retifera* Bandy; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 9

21. *Stilostomella cocoaensis* (Cushman); side view, X 32; Shubuta Member of Yazoo Clay at locality 1, sample 11

22, 23. *Fursenkoina dibollensis* (Cushman and Applin); side views, X 60; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

24, 25. *Marginulina cocoaensis* Cushman; side views, X 32; Shubuta Member of Yazoo Clay at locality 1, sample 13

26. *Marginulina laeviuscula* Cushman and Bermudez; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 11

27. *Chilostomella cylindroides* Reuss; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14

28. *Vaginulinopsis* sp. 1; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14

(continued)

PLATE 22–Continued

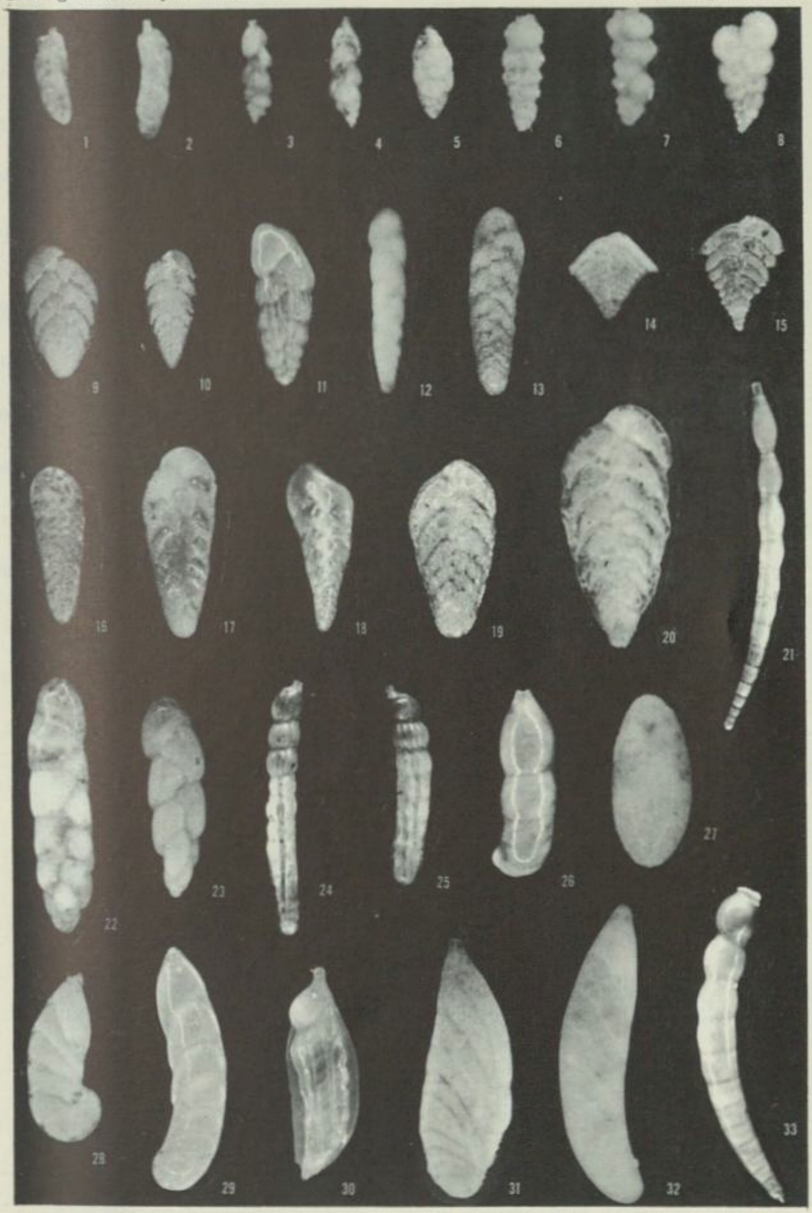
Figure 29. *Marginulina* sp. 1; side view, X 40; Shubuta Member of Yazoo Clay at locality 4, sample 8

30. *Vaginulina costifera* (Cole); side view, X 80; Shubuta Member of Yazoo Clay at locality 1, sample 13

31. *Vaginulina* sp. 1; side view, X 32; Marianna Limestone at locality 5, sample 2

32. *Vaginulina lalickeri* (Cushman); side view, X 40; Red Bluff Clay at locality 2, sample 6

33. *Stilostomella jacksonensis* (Cushman and Applin); side view, X 32; Shubuta Member of Yazoo Clay at locality 1, sample 13



ANGULOGERINA, BITUBULOGENERINA, BOLIVINA, BOLIVINELLA, CHILOGUEMBELINA, CHILOSTOMELLA, FURSENKOINA, LOXOSTOMUM, MARGINULINA, STILOSTOMELLA, VAGINULINA, VAGINULINOPSIS

PLATE 23

Figure 1, 2. *Pseudoglandulina ovata* (Cushman); side views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14

3. *Saracenaria hantkeni* Cushman; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

4. *Saracenaria ornatula* Cushman and Bermudez; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 11

5. *Saracenaria* sp. 1; side view, X 40; Marianna Limestone at locality 4, sample 2

6, 7. *Pseudoglandulina conica* (Neugeboren); side views, microspheric form (fig. 6), megalospheric form (fig. 7), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

8. *Saracenaria* sp. 2; side view, X 24; Shubuta Member of Yazoo Clay at locality 5, sample 9

9. *Marginulina hantkeni* Bandy; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 10

10. *Marginulina multiplicata* Bergquist; side view, X 60; Shubuta Member of Yazoo Clay at locality 4, sample 8

11. *Marginulinopsis* sp. 1; side view, X 24; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3

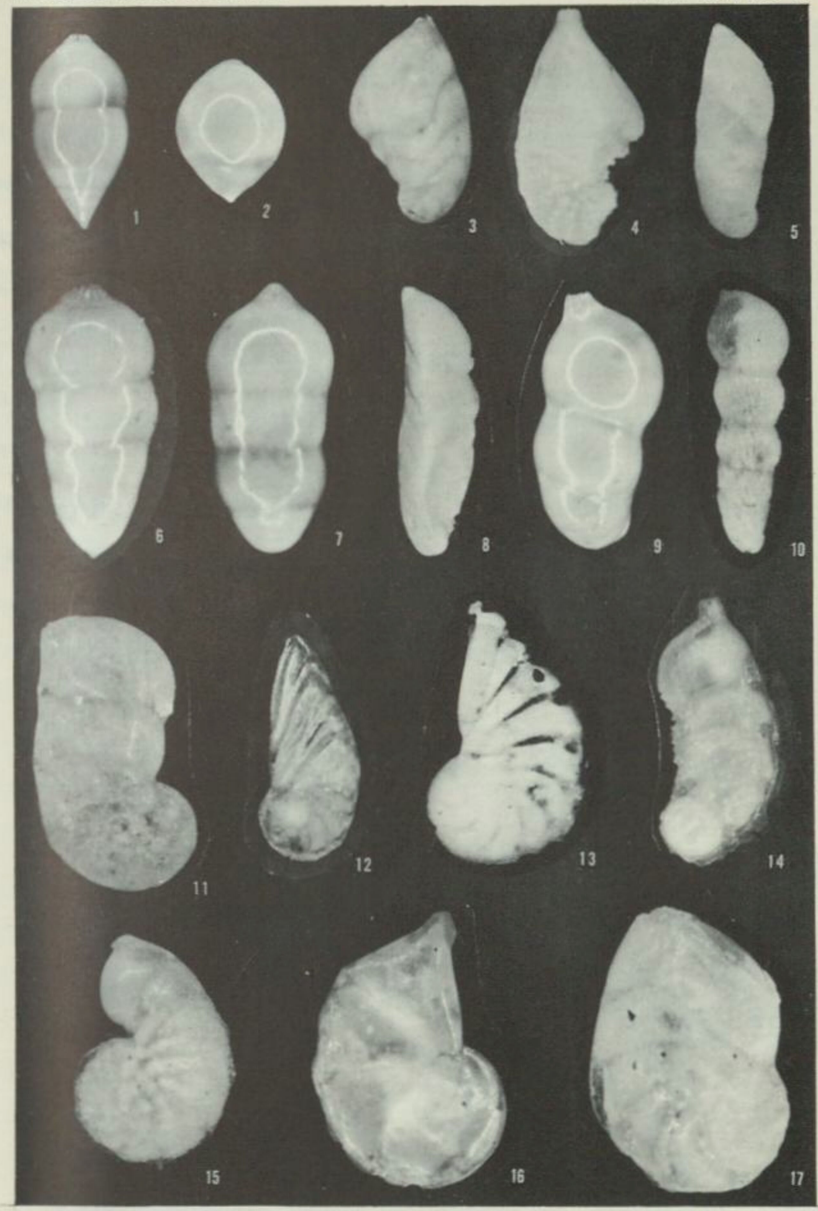
12, 13. *Astacolus danvillensis* (Howe and Wallace); side views, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 12

14. *Marginulina digitalis* Bandy; side view, X 60; Red Bluff Clay at locality 7, sample 6

15. *Robulus inusitatus* Cushman; side view, X 24; Shubuta Member of Yazoo Clay at locality 1, sample 13

16. *Lenticulina convergens* (Bornemann); side view, X 40; Pachuta Marl Member of Yazoo Clay at locality 1, sample 16

17. *Marginulinopsis* sp. 1; side view, X 24; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3



ASTOCOLUS, LENTICULINA, MARGINULINA, MARGINULINOPSIS, PSEUDOGLANDULINA, ROBULUS, SARACENARIA

PLATE 24

Figure 1. *Robulus vicksburgensis* (Cushman); side view, X 47; Marianna Limestone at locality 4, sample 1

2. *"Darbyella" danvillensis* (Howe and Chambers); side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 14

3. *Robulus rectidorsatus* Bandy; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

4. *Robulus cultratus* Montfort; side view, X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

5. *Robulus carolinianus* Cushman; side view, X 40; Red Bluff Clay at locality 2, sample 5

6. *Robulus limbosus* (Reuss); side view, X 24; Shubuta Member of Yazoo Clay at locality 1, sample 13

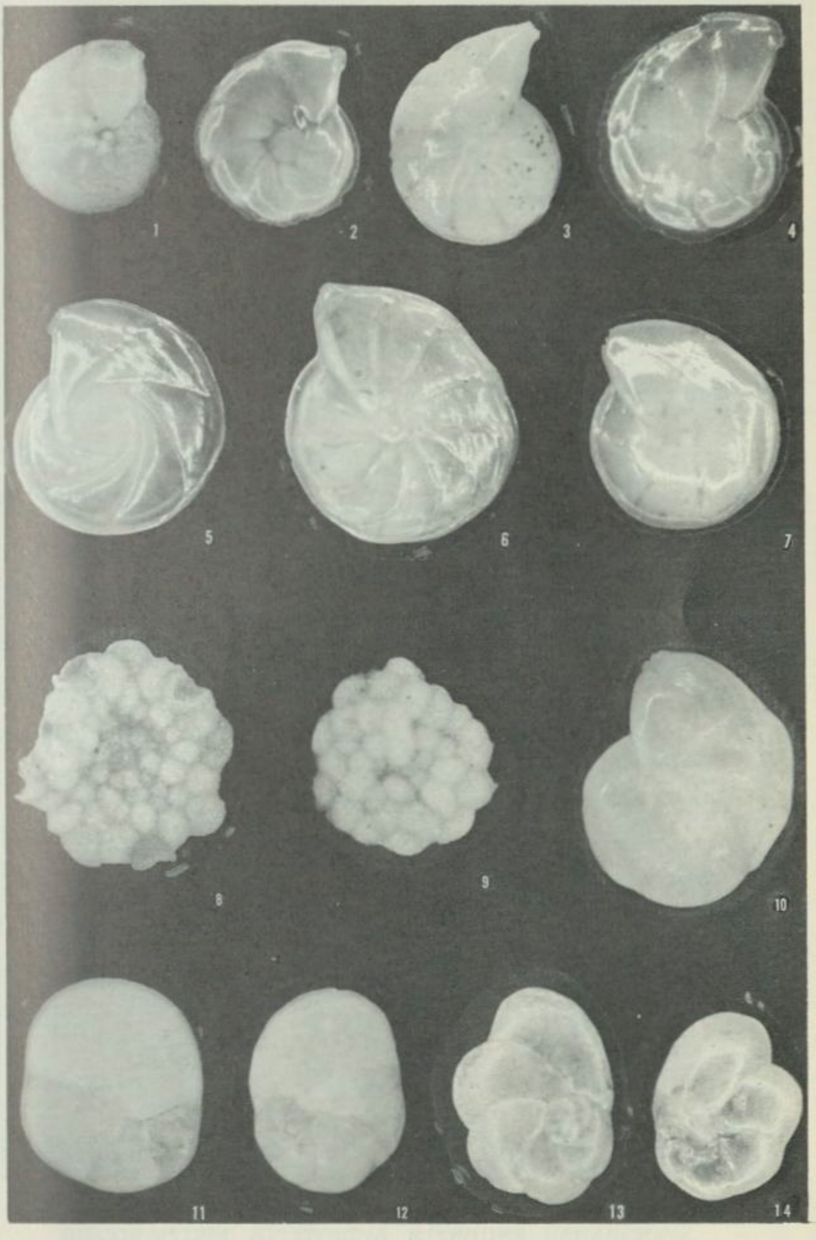
7. *Robulus clericii* (Fornasini); side view, X 40; Shubuta Member of Yazoo Clay at locality 5, sample 9

8, 9. *Planorbulina larvata* Parker and Jones; side view, X 40; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3

10. *Robulus davisi* Bandy; side view, X 40; Shubuta Member of Yazoo Clay at locality 5, sample 9

11, 12. *Cancris* sp. 1; ventral view (fig. 11), dorsal view (fig. 12), X 40; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3

13, 14. *Cancris cocoaensis* Cushman; dorsal view (fig. 13), ventral view (fig. 14), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13



CANCRIS, "DARBYELLA", PLANORBULINA, ROBULUS

PLATE 25

Figure 1, 2. *Ceratobulimina alazanensis* Cushman; dorsal view (fig. 1), ventral view (fig. 2), X 47; Shubuta Member of Yazoo Clay at locality 5, sample 10

3. *Pullenia subcarinata* (d'Orbigny); side view, X 47; Shubuta Member of Yazoo Clay at locality 1, sample 10

4, 5. *Discorbitura dignata* Bandy; dorsal view (fig. 4), ventral view (fig. 5), X 47; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3

6, 7. *Siphonina danvillensis* Howe and Wallace; ventral view (fig. 7), X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13

8, 9. *Siphonina advena* Cushman; dorsal view (fig. 8), ventral view (fig. 9), X 47; Red Bluff Clay at locality 5, sample 4

10. *Siphonina advena eocenica* Cushman and Applin; dorsal view, X 47; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

11, 12. *Asterigerina gallowayi* Bandy; ventral view (fig. 11), dorsal view (fig. 12), X 47; Shubuta Member of Yazoo Clay at locality 5, sample 11

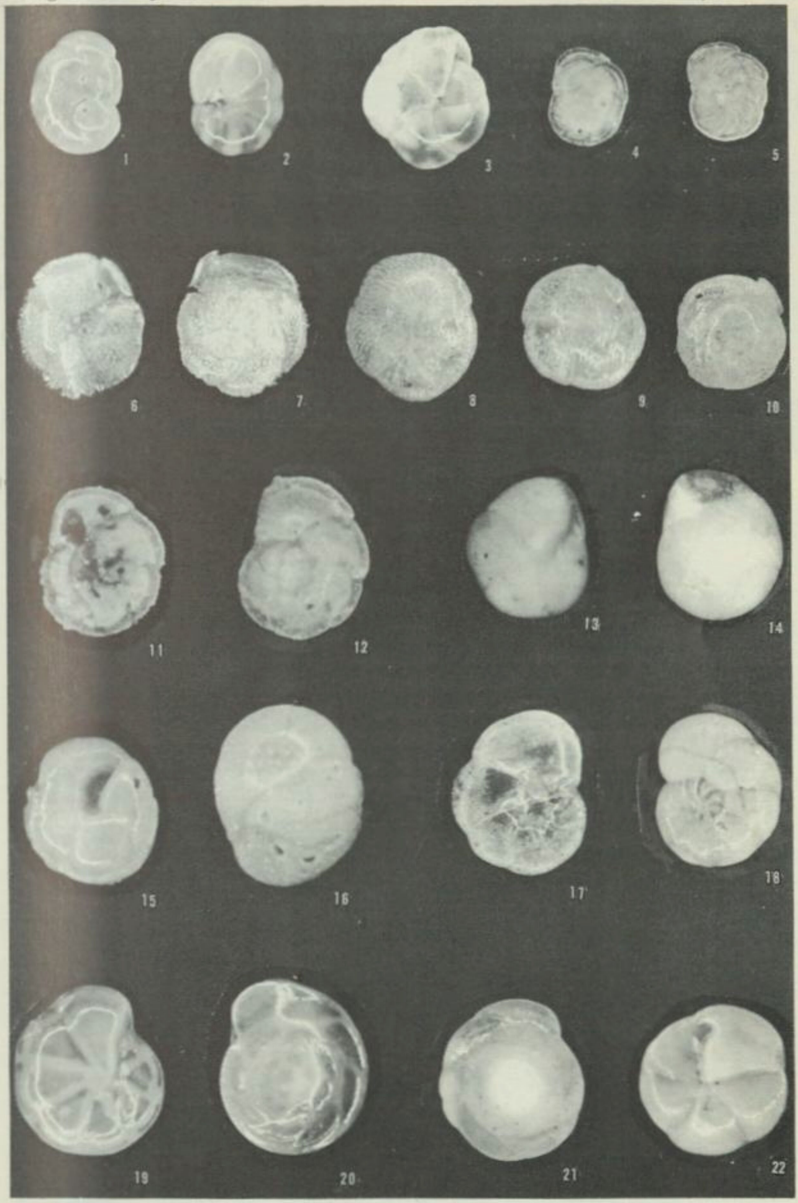
13, 14. *Alabamina wilcoxensis* Toulmin; ventral view (fig. 13), dorsal view (fig. 14), X 47; Red Bluff Clay at locality 2, sample 5

15, 16. *Lamarckina byramensis* Cushman; ventral view (fig. 15), dorsal view (fig. 16), X 47; Red Bluff Clay at locality 2, sample 4

17, 18. *Discorbis cocoaensis* Cushman and Garrett; ventral view (fig. 17), dorsal view (fig. 18), X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13

19, 20. *Epistomina elegans* (d'Orbigny); ventral view (fig. 19), dorsal view (fig. 20), X 40; Shubuta Member of Yazoo Clay at locality 1, sample 13

21, 22. *Eponides jacksonensis* (Cushman and Applin); dorsal view (fig. 21), ventral view (fig. 22), X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17



ALABAMINA, ASTERIGERINA, CERATOBULIMINA, DISCORBIS, DISCORBITURA, EPISTOMINA, EPONIDES, LAMARCKINA, PULLENIA, SIPHONINA

PLATE 26

Figure 1, 2. *Eponides* sp. 1; dorsal view (fig. 1), ventral view (fig. 2), X 40; Marianna Limestone at locality 4, sample 1

3, 4. *Eponides obesa* (Bandy); dorsal view (fig. 3), ventral view (fig. 4), X 40; Red Bluff Clay at locality 2, sample 6

5, 6. *Eponides byramensis* Cushman; dorsal view (fig. 5), ventral view (fig. 6), X 40; Marianna Limestone at locality 5, sample 1

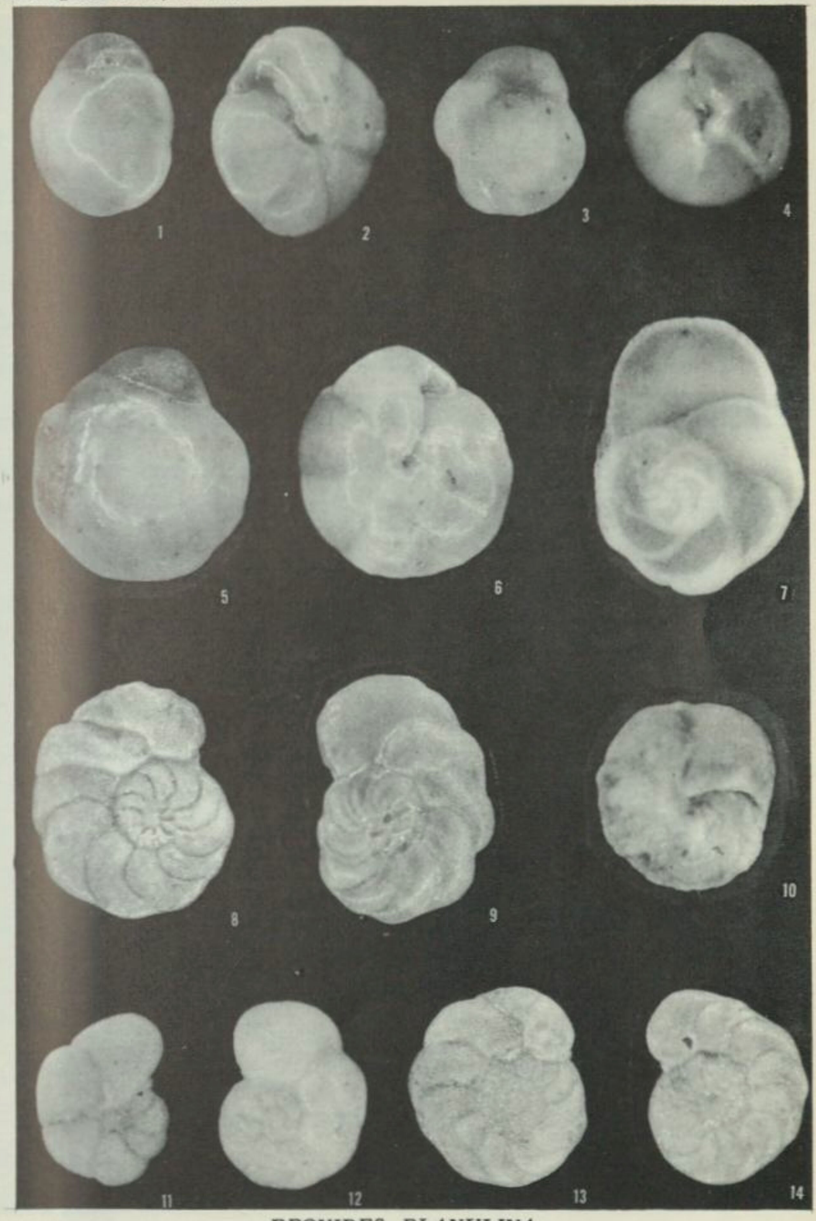
7. *Eponides mariannaensis* Cushman; dorsal view, X 40; Marianna Limestone at locality 4, sample 1

8, 9. *Planulina cocoaensis* Cushman; dorsal view (fig. 8), ventral view (fig. 9), X 40; Shubuta Member of Yazoo Clay at locality 4, sample 11

10. *Eponides mariannaensis* Cushman; ventral view, X 40; Marianna Limestone at locality 4, sample 1

11, 12. *Planulina lobatulus* (d'Orbigny); ventral view (fig. 11), dorsal view (fig. 12), X 40; Cocoa Sand Member of Yazoo Clay at locality 1, sample 17

13, 14. *Planulina cooperensis* Cushman; dorsal view (fig. 13), ventral view (fig. 14), X 40; Shubuta Member of Yazoo Clay at locality 4, sample 11



EPONIDES, PLANULINA

PLATE 27

Figure 1, 2. *Anomalina cocoaensis* Cushman; dorsal view (fig. 1), ventral view (fig. 2), X 40; Shubuta Member of Yazoo Clay at locality 4, sample 11

3, 4. *Anomalina danvillensis* Howe and Wallace; dorsal view (fig. 3), ventral view (fig. 4), X 47; Shubuta Member of Yazoo Clay at locality 1, sample 13

5, 6. *Anomalina bilateralis* Cushman; dorsal view (fig. 5), ventral view (fig. 6), X 40; Red Bluff Clay at locality 2, sample 6

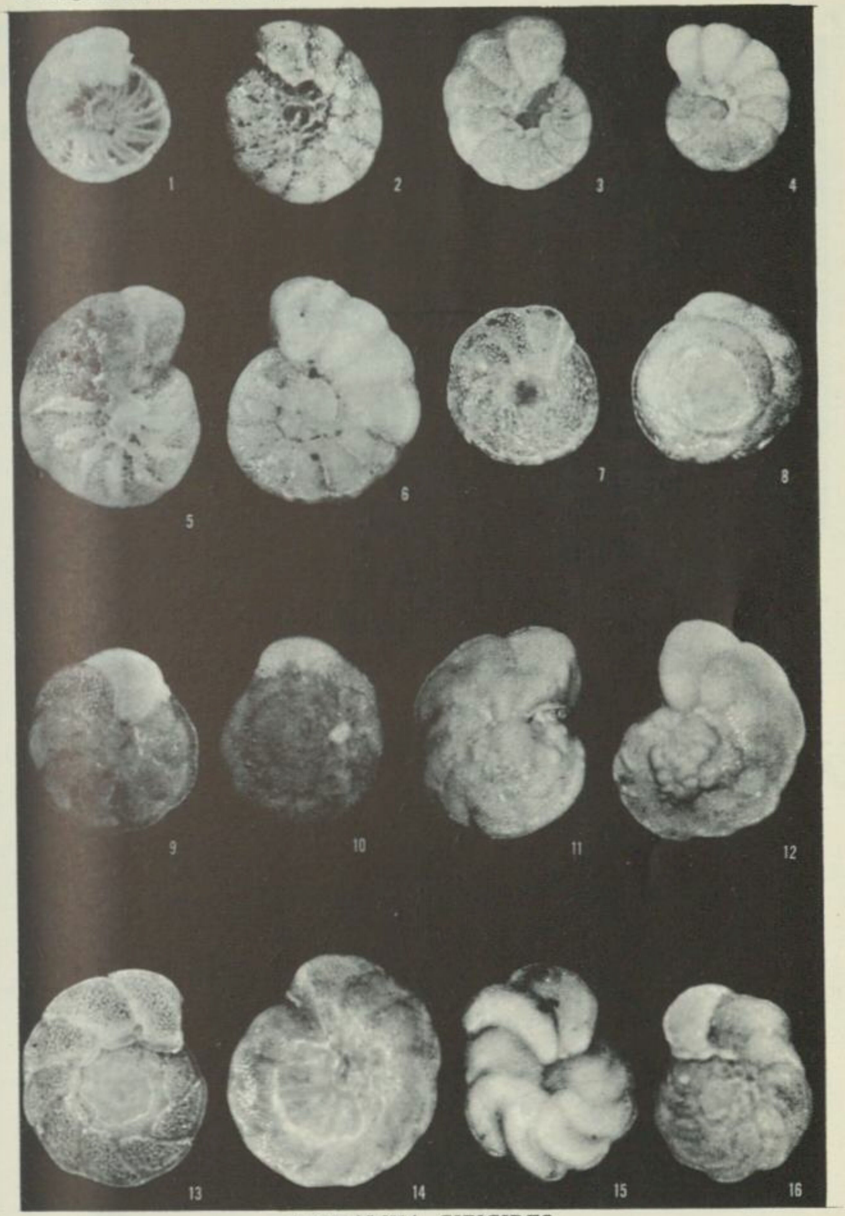
7, 8. *Cibicides cocoaensis* (Cushman); ventral view (fig. 7), dorsal view (fig. 8), X 40; Shubuta Member of Yazoo Clay at locality 4, sample 11

9, 10. *Cibicides* sp. 1; ventral view (fig. 9), dorsal view (fig. 10), X 40; Pachuta Marl Member of Yazoo Clay at locality 4, sample 12

11, 12. *Cibicides* sp. 2; ventral view (fig. 11), dorsal view (fig. 12), X 40; Marianna Limestone at locality 5, sample 2

13, 14. *Cibicides pippeni* Cushman and Garrett; dorsal view (fig. 13), ventral view (fig. 14), X 40; Red Bluff Clay at locality 2, sample 6

15, 16. *Cibicides pseudoungerianus* (Cushman); ventral view (fig. 15), dorsal view (fig. 16), X 40; Mint Spring Marl Member of Marianna Limestone at locality 3, sample 3



ANOMALINA, CIBICIDES

PLATE 28

Figure 1. *Cibicides pippeni stavensis* Bandy; dorsal view, X 40; Red Bluff Clay at locality 2, sample 7

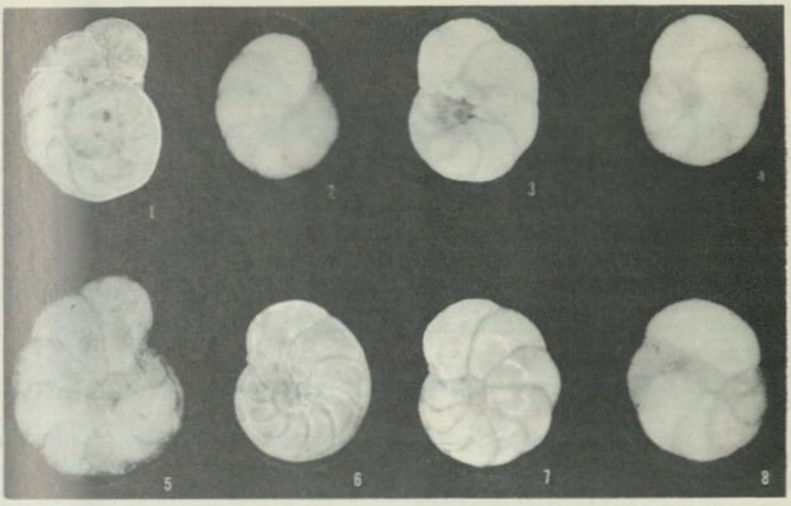
2, 3. *Hanzawaia* sp. 1; ventral view (fig. 2), dorsal view (fig. 3), X 40; Marianna Limestone at locality 6, sample 1

4. *Hanzawaia* sp. 2; ventral view, X 40; Forest Hill Sand at locality 4, sample 3

5. *Cibicides pippeni stavensis* Bandy; ventral view, X 40; Red Bluff Clay at locality 2, sample 7

6, 7. *Hanzawaia mississippiensis* (Cushman); dorsal view (fig. 6), ventral view (fig. 7), X 40; Marianna Limestone at locality 3, sample 1

8. *Hanzawaia* sp. 2; dorsal view, X 40; Forest Hill Sand at locality 4, sample 3



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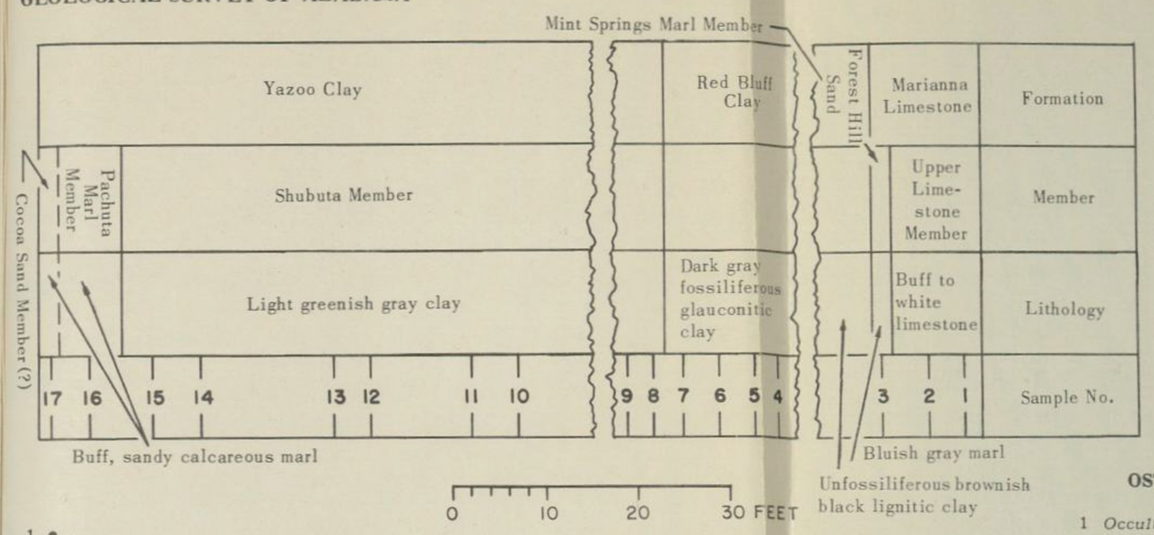
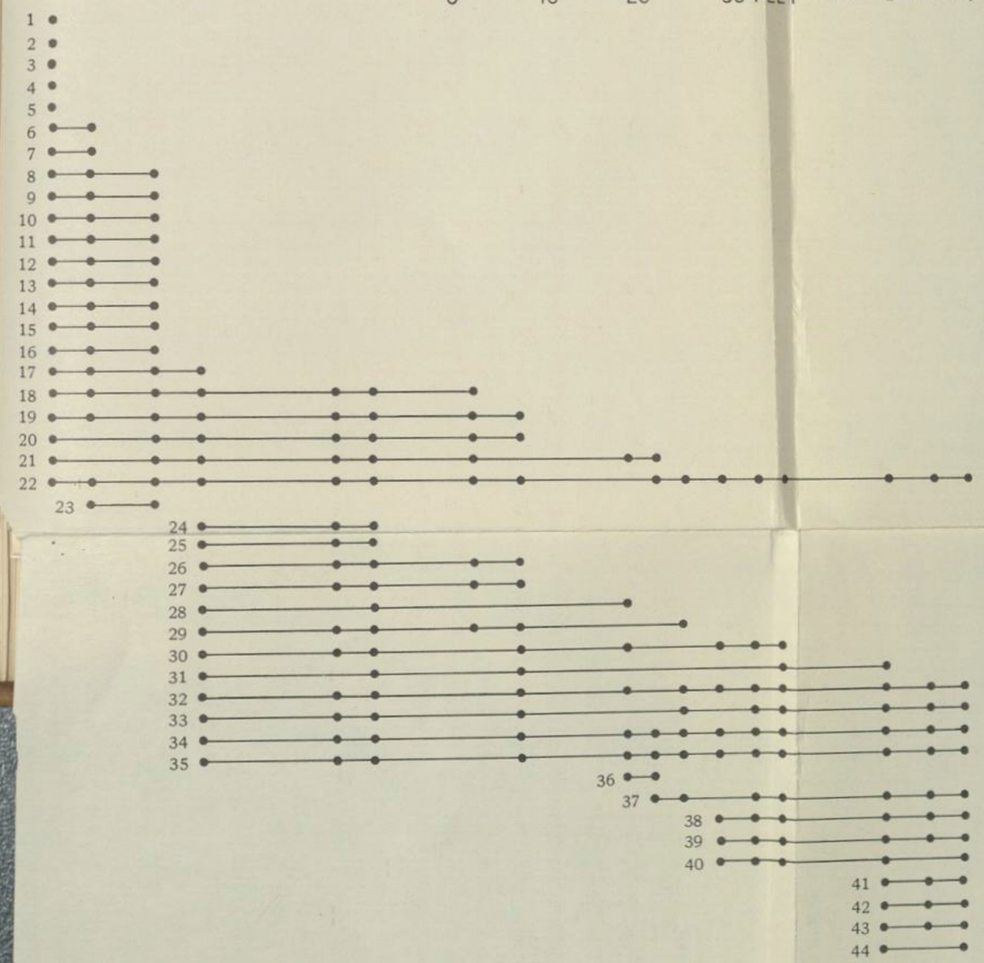
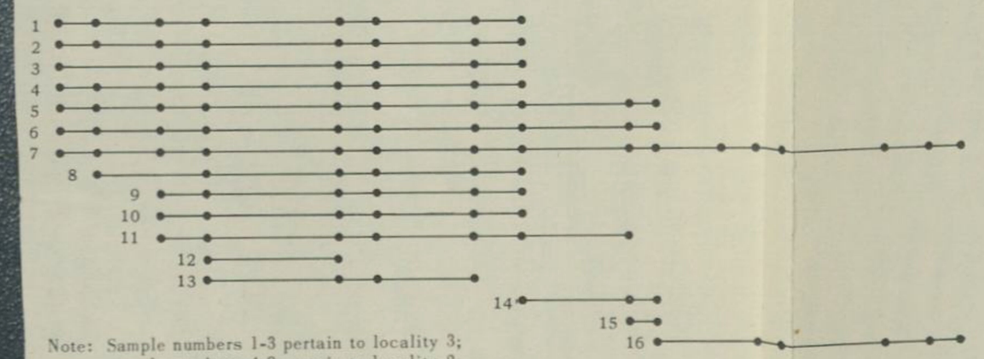






Note: Sample numbers 1-3 pertain to locality 3;
sample numbers 4-9 pertain to locality 2;
sample numbers 10-17 pertain to locality 1.

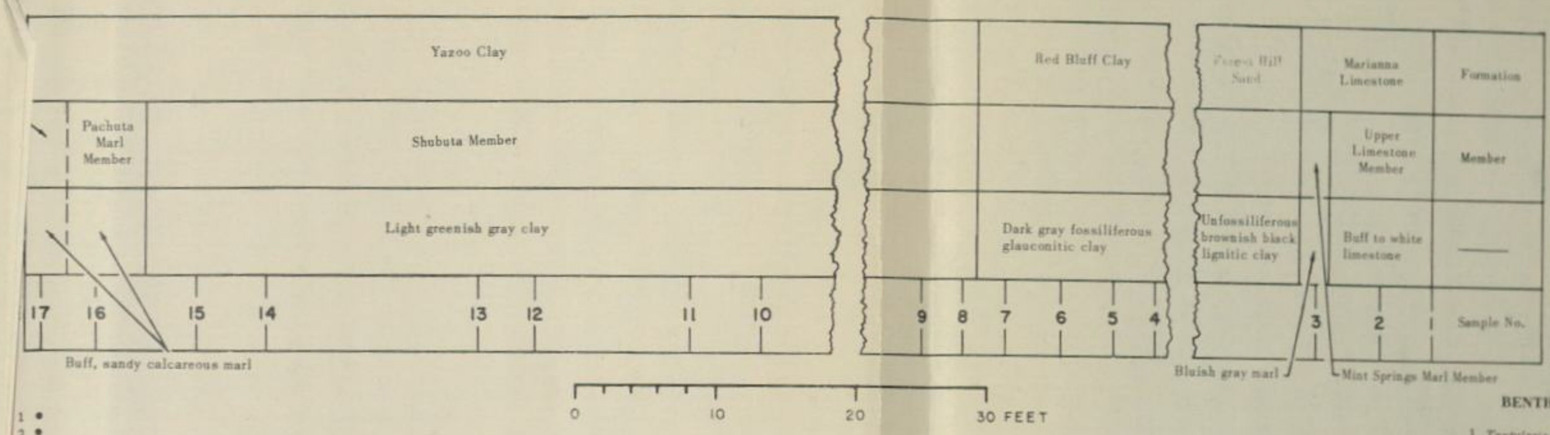
OSTRACODA

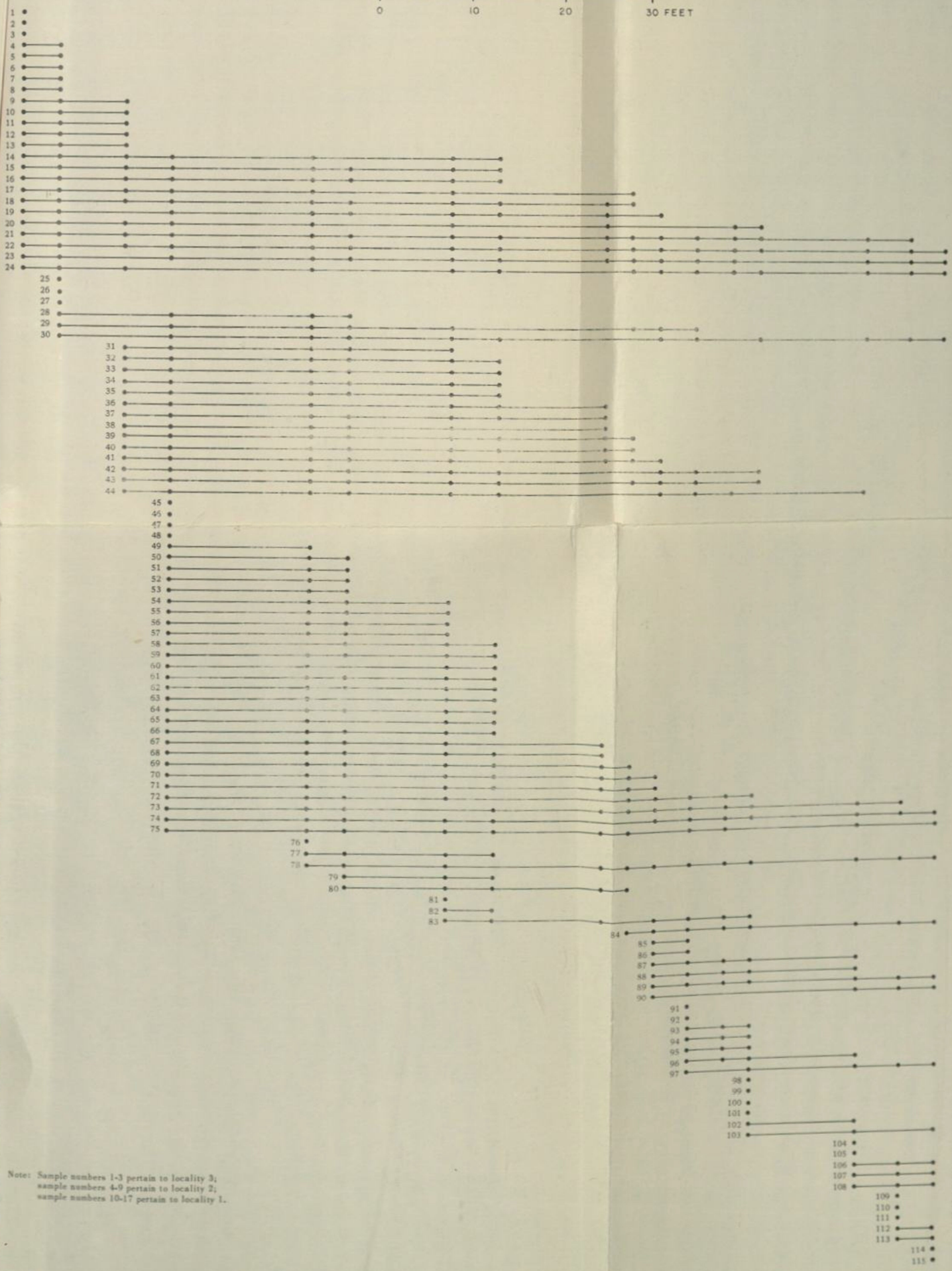
1 *Occultocythereis broussardi*
2 *Cytherelloidea cocoaensis*
3 *Brachycythere mississippiensis*
4 *Digmocythere watervalleyensis*
5 *Haplocytheridea* sp. 1
6 *Cyamocytheridea watervalleyensis*
7 *Triginglymus* n. sp. 1
8 *Echinocythereis jacksonensis*
9 *Actinocythereis* n. sp. 2
10 N. Gen. n. sp. 1
11 *Clithrocytheridea grigsbyi*
12 *C. garretti*
13 *Cytheretta jacksonensis*
14 *Brachycythere watervalleyensis*
15 *"Cythereis" hysonensis*
16 *Actinocythereis* n. sp. 3
17 *Isocythereis couleycreekensis*
18 *Actinocythereis gibsonensis*
19 *Henryhowella florienensis*
20 *"Cythereis" dohmi*
21 *Haplocytheridea montgomeryensis*
22 *Digmocythere russelli*
23 *Actinocythereis* n. sp. 1
24 *Trachyleberis montgomeryensis*
26 *Haplocytheridea ehlersi*
27 *Buntonia* n. sp. 1
28 *Loxoconcha creolensis*
29 *Acanthocythereis* n. sp. 1
30 *Buntonia israelskyi*
31 *Argilloecia hiwanneensis*
32 *Krithe hiwanneensis*
33 *Bythocypris gibsonensis*
34 *Pterygocythereis ivani*
35 *Echinocythereis mcguirti*
36 *Trachyleberis* n. sp. 1
37 *Actinocythereis dacyi*
38 *Paracypris rosefieldensis*
39 *Trachyleberidea blanpiedi*
40 *Eucythere woodwardensis*
41 *Jugosocythereis vicksburgensis*
42 *Propontocypris mississippiensis*
43 *Hemicythere kniffeni*
44 *Cytherella* sp. 1

PLANKTONIC FORAMINIFERA

1 *Pseudohastigerina micra*
2 *Hantkenina alabamensis*
3 *Globigerina pseudoampliapertura*
4 *Globorotalia centralis*
5 *Globigerina yeguaensis pseudovenezuelana*
6 *G. yeguaensis yeguaensis*
7 *G. tripartita tripartita*
8 *G. ouachitaensis*
9 *Cribrohantkenina inflata*
10 *Globorotalia increbescens*
11 *G. cerroazulensis*
12 *Globigerina* sp. 1
13 *Hastigerina danvillensis*
14 *Globigerinita pera*
15 *Globigerina gortanii*
16 *G. ampliapertura*

Range chart of ostracods and planktonic foraminifers from the composite section in Wayne and Clarke Counties, Miss.





BENTHONIC FORAMINIFERA

1 *Textularia adalta*
2 *T. dibollensis*
3 *T. sp. 2*
4 *T. sp. 3*
5 *Lankesterina frondea*
6 *Sigmomorphina costifera*
7 *Textularia sp. 1*
8 *Siphonina advena eocenica*
9 *Planulina lobatulus*
10 *Hanzawaia sp. 2*
11 *Textularia porrecta*
12 *Globulina inaequalis caribaea*
13 *Cibicides sp. 1*
14 *Cibicides cocoaensis*
15 *Uvigerina cocoaensis*
16 *U. tapilensis*
17 *Eponides jacksonensis*
18 *Bulimina jacksonensis*
19 *Uvigerina gardnerae*
20 *Bulimina ovata*
21 *Robulus inusitatus*
22 *Spiroplectammina mississippiensis*
23 *Globulina gibba*
24 *Guttulina irregularis*
25 *Lenticulina convergens*
26 *Angulogerina sp. 1*
27 *Robulus clericii*
28 *Fursenkoina dibollensis*
29 *Uvigerina glabrans*
30 *Hanzawaia mississippiensis*
31 *Stilostomella jacksonensis*
32 *Astacolus danvillensis*
33 *Marginulina cocoaensis*
34 *Stilostomella cocoaensis*
35 *Sigmomorphina jacksonensis*
36 *Frondicularia tenuissima*
37 *Robulus cultratus*
38 *R. limbosus*
39 *Cancris cocoaensis*
40 *Planulina cooperensis*
41 *Pseudogaudryina jacksonensis*
42 *Karreriella advena*
43 *Siphonina danvillensis*
44 *Massilina decorata*
45 *Darbyella danvillensis*
46 *Vaginulinopsis sp. 1*
47 *Chilostomella cylindroides*
48 *Pseudoglandulina ovata*
49 *Palmula cf. vaughni*
50 *Vaginulina costifera*
51 *Robulus rectidorsatus*
52 *Bolivina alazanensis*
53 *Vulvulina advena*
54 *Buliminella longicamerata*
55 *Pseudoglandulina conica*
56 *Saracenaria ornatula*
57 *Pseudoclavulina cocoaensis*
58 *Massilina cookei*
59 *Spiroloculina sp. 1*
60 *Marginulina hantkeni*
61 *Bolivina gracilis*
62 *B. striatellata*
63 *Angulogerina danvillensis*
64 *Uvigerina (2 apertured)*
65 *Anomalina danvillensis*
66 *Ramulina sp. 1*
67 *Marginulina laevisecula*
68 *Subcarinata quinquiloba*
69 *Discorbis cocoaensis*
70 *Bolivina dalli*
71 *Epistomina elegans*
72 *Liebusella hyrnemensis*
73 *Robulus carolinianus*
74 *Cibicides pippeni*
75 *Saracenaria hantkeni*
76 *Guttulina spicaeformis*
77 *Eponides ouachitaensis*
78 *E. byramensis*
79 *Plectofrondicularia garretti*
80 *Uvigerina jacksonensis*
81 *Uvigerina danvillensis*
82 *Anomalina cocoaensis*
83 *Vaginulina lalickeri*
84 *Vulvulinella octocameratus*
85 *Cornuspira [illegible]*
86 *Eponides obesa*
87 *Uvigerina vicksburgensis*
88 *Angulogerina byramensis*
89 *Anomalina bilateralis*
90 *Bolivina mississippiensis*
91 *Bolivinella sp. 1*
92 *Cibicides pippeni alavensis*
93 *Pyrgo inornata*
94 *Spiroloculina occulta*
95 *Lamarckina byramensis*
96 *Alabamina wilcoxensis*
97 *Textularia subhaueri*
98 *Bolivinella subspectinata*
99 *Spiroplectammina alabamensis*
100 *Textularia haueri*
101 *Globulina alabamensis*
102 *Discorbitura digna*
103 *Eponides mariannaensis*
104 *Marginulinopsis sp. 1*
105 *Cibicides pseudoungerianus*
106 *Siphonina advena*
107 *Cancris sp. 1*
108 *Planorbulina larvata*
109 *Uvigerina byramensis*
110 *Pyrulina sp. 1*
111 *Textularia tumidulum*
112 *Palmula caelata*
113 *Guttulina problema*
114 *Rousselle byramensis*
115 *Loxostomum vicksburgensis*

Note: Sample numbers 1-3 pertain to locality 3;
sample numbers 4-9 pertain to locality 2;
sample numbers 10-17 pertain to locality 1.

Range chart of benthonic foraminifers from the composite section in Wayne and Clarke Counties, Miss.

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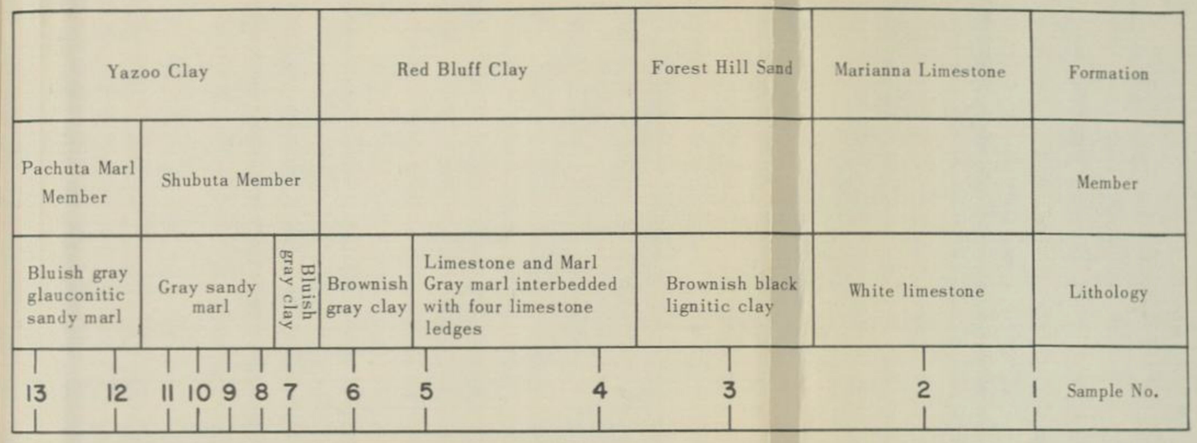
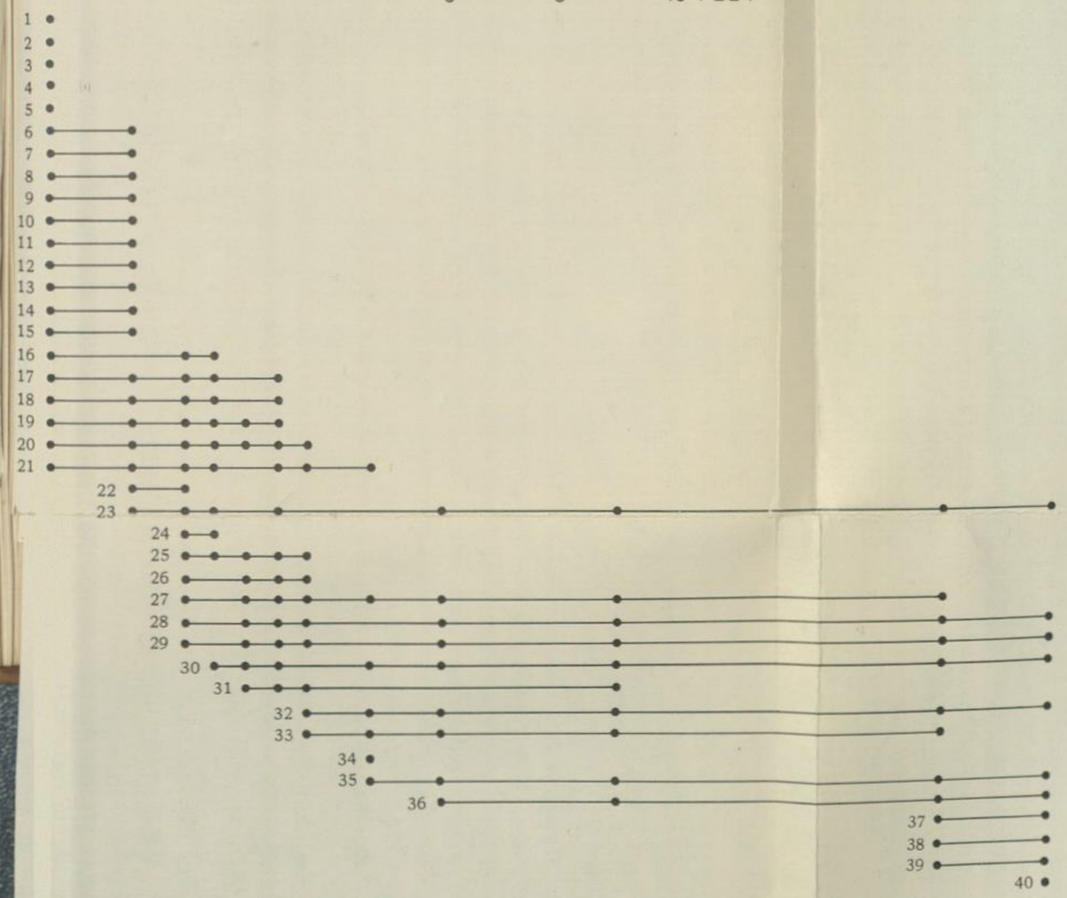
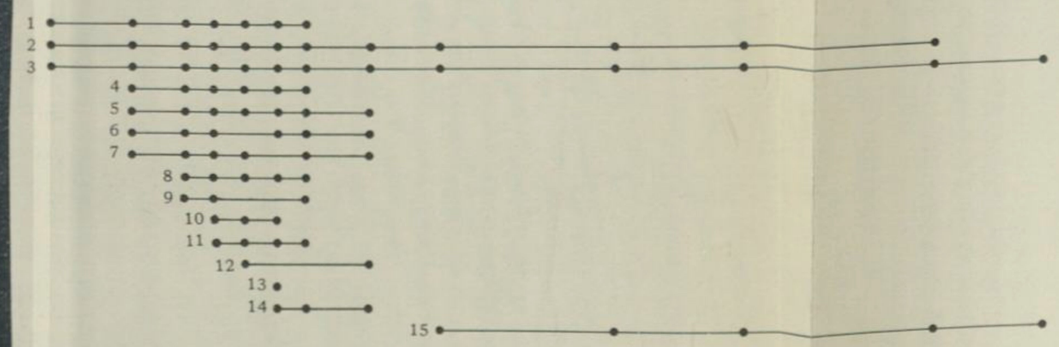






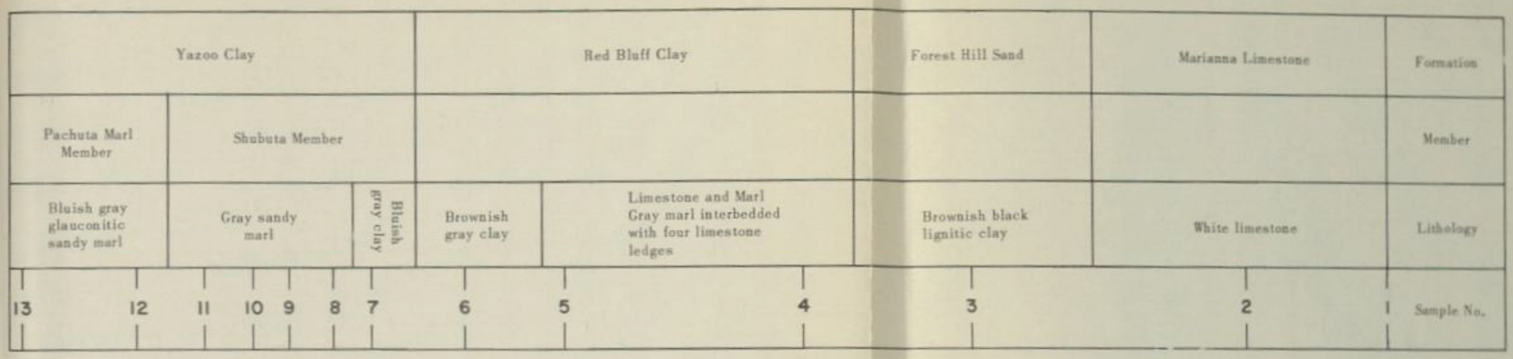
Range chart of ostracods and planktonic foraminifers from St. Stephens quarry.

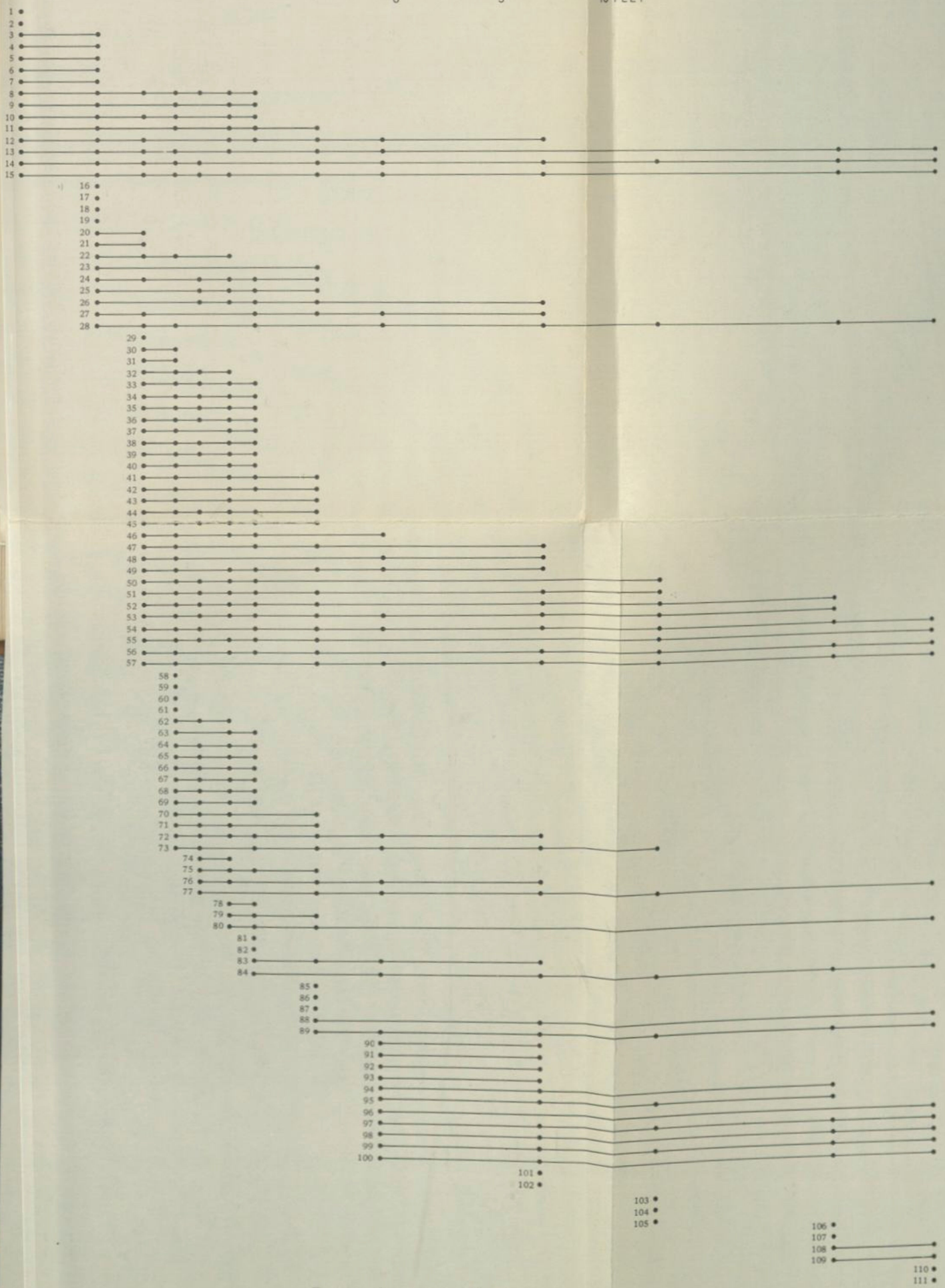
OSTRACODA

1 *Konarocythere spurgeonae*
2 *Cytheretta jacksonensis*
3 *Bairdoppilata ocalana*
4 *Jugosocythereis bicarinata*
5 *Paracytheridea belhavenensis*
6 *Cytherelloidea cocoaensis*
7 *Clithrocytheridea grigsbyi*
8 *C. caldwellensis*
9 *C. garretti*
10 *Cyamocytheridea watervalleyensis*
11 *Digmocythere watervalleyensis*
12 N. Gen. n. sp. 1
13 *Loxoconcha creolensis*
14 *Echinocythereis jacksonensis*
15 *Actinocythereis* n. sp. 3
16 *Actinocythereis gibsonensis*
17 *"Cythereis" dohmi*
18 *Isocythereis couleycreekensis*
19 *Haplocytheridea montgomeryensis*
20 *Loxoconcha concentrica*
21 *Henryhowella florienensis*
22 *Occultocythereis broussardi*
23 *Digmocythere russelli*
24 *Actinocythereis* n. sp. 1
25 *Acanthocythereis* n. sp. 1
26 *Buntonia israelskyi*
27 *Krithe* sp. 1
28 *Pterygocythereis ivani*
29 *Bythocypris gibsonensis*
30 *Cytherella hannai*
31 *Trachyleberis montgomeryensis*
32 *Actinocythereis dacyi*
33 *Krithe hiwanneensis*
34 *Trachyleberis* n. sp. 2
35 *Trachleberidea blanpiedi*
36 *Echinocythereis mcguirti*
37 *Cytherella* sp. 1
38 *Propontocypris mississippiensis*
39 *Jugosocythereis vicksburgensis*
40 *Paracytheridea woodwardensis*

PLANKTONIC FORAMINIFERA

1 *Pseudohastigerina micra*
2 *Globigerina yeguaensis yeguaensis*
3 *G. tripartita tripartita*
4 *Hantkenina alabamensis*
5 *Globigerina yeguaensis pseudovenezuelana*
6 *G. pseudoampliapertura*
7 *Globorotalia centralis*
8 *G. cerroazulensis*
9 *G. increbescens*
10 *Cribrohantkenina inflata*
11 *Hastigerina danvillensis*
12 *Globigerinita pera*
13 *Globigerina turritilina praeturritilina*
14 *G.* sp. 1
15 *G. ampliapertura*





BENTHONIC FORAMINIFERA

1 *Textularia dibollensis*
2 *T. porrecta*
3 *T. adalta*
4 *T. recta*
5 *Planulina lobatulus*
6 *Siphonina advena eocenica*
7 *Hanzawaia* sp. 1
8 *Eponides jacksonensis*
9 *Spiroplectammina mississippiensis*
10 *Uvigerina jacksonensis*
11 *Karreriella advena*
12 *Uvigerina gardnerae*
13 *Liebusella byramensis*
14 *Guttulina irregularis*
15 *Robulus inusitatus*
16 *Bolivina taylori*
17 *Sigmomorphina costifera*
18 *Lanksterina frondea*
19 *Textularia* sp. 1
20 *T.* sp. 2
21 *Angulogerina* sp. 1
22 *Cibicides* sp. 1
23 *Spiroplectammina alabamensis*
24 *Globobulimina ovata*
25 *Bolivina gracilis*
26 *Angulogerina danvillensis*
27 *Virgulina dibollensis*
28 *Hanzawaia mississippiensis*
29 *Rectoglandulina conica*
30 *Astacolus danvillensis*
31 *Sigmomorphina jacksonensis*
32 *Marginulina cocoaensis*
33 *Planulina cocoaensis*
34 *P. cooperensis*
35 *Stilostomella jacksonensis*
36 *Vulvulina advena*
37 *Pseudogaudryina* sp. 1
38 *Flabellina lanceolata*
39 *Pseudogaudryina jacksonensis*
40 *Saracenaria ornatula*
41 *Stilostomella cocoaensis*
42 *Bulimina jacksonensis*
43 *Uvigerina topilensis*
44 *Cibicides cocoaensis*
45 *Bolivina silicicostis*
46 *Liebusella byramensis turgida*
47 *Uvigerina glabrans*
48 *Alabamina wilcoxensis*
49 *Massilina decorata*
50 *Uvigerina cocoaensis*
51 *Siphonina danvillensis*
52 *Saracenaria hantkeni*
53 *Robulus cultratus*
54 *Anomalina bilateralis*
55 *Robulus carolinianus*
56 *Globulina gibba*
57 *Lenticulina convergens*
58 *Vaginulina lalickeri*
59 *Darbyella danvillensis*
60 *Pyrulina* sp. 1
61 *Uvigerina* (2 apertured)
62 *Anomalina cocoaensis*
63 *Uvigerina dumblei*
64 *Discorbis cocoaensis*
65 *Robulus rectidorsatus*
66 *Marginulina* sp. 1
67 *Pseudoclavulina cocoaensis*
68 *Marginulina multiplicata*
69 *Bolivina retifera*
70 *Cancris cocoaensis*
71 *Bolivina alazanensis*
72 *B. delli*
73 *Robulus limbosus*
74 *Hanzawaia westi*
75 *Spiroloculina* sp. 1
76 *Subcarinata quinqueloba*
77 *Eponides obesa*
78 *Flabellina* sp. 1
79 *Anomalina danvillensis*
80 *Ramulina* sp. 1
81 *Marginulina laeviuscula*
82 *Bolivina jacksonensis*
83 *Cibicides pseudoungerianus*
84 *Valvulineria octocamerata*
85 *Rectoglandulina ovata*
86 *Eponides ouachitaensis*
87 *Epistomina elegans*
88 *Globulina alabamensis*
89 *Cibicides pippeni*
90 *Bolivina mississippiensis*
91 *Angulogerina vicksburgensis*
92 *A. byramensis*
93 *Discorbitura dignata*
94 *Guttulina problema*
95 *Eponides byramensis*
96 *Textularia subhauseri*
97 *Uvigerina vicksburgensis*
98 *Eponides mariannaensis*
99 *Siphonina advena*
100 *Palmula caelata*
101 *Cibicides danvillensis*
102 *C. cookei*
103 *Cerotobulimina alazanensis*
104 *Lamarckina byramensis*
105 *Hanzawaia* sp. 2
106 *Saracenaria* sp. 1
107 *Ammobaculites subagglutinans*
108 *Eponides* sp. 1
109 *Textularia conica*
110 *Textularia tumidulum*
111 *Robulus vicksburgensis*

Range chart of benthonic foraminifers from St. Stephens quarry.

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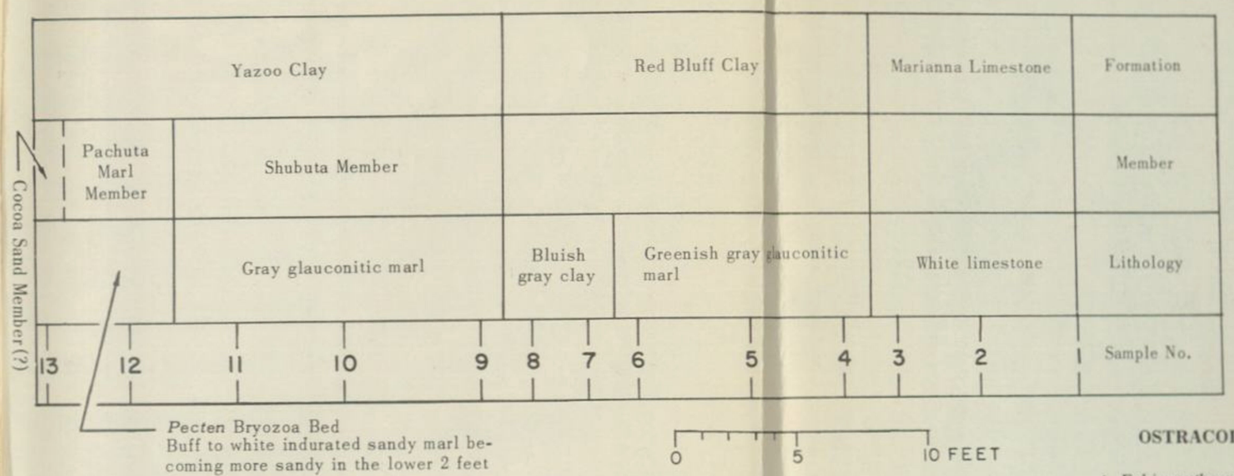
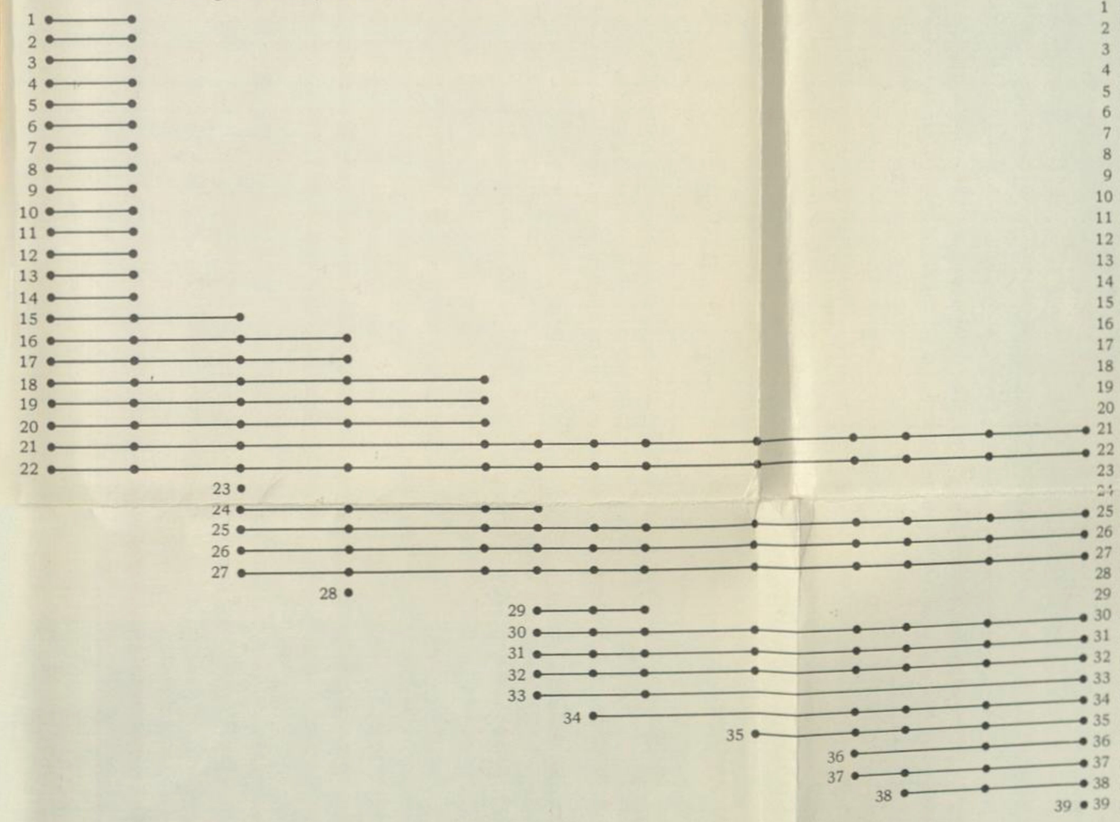
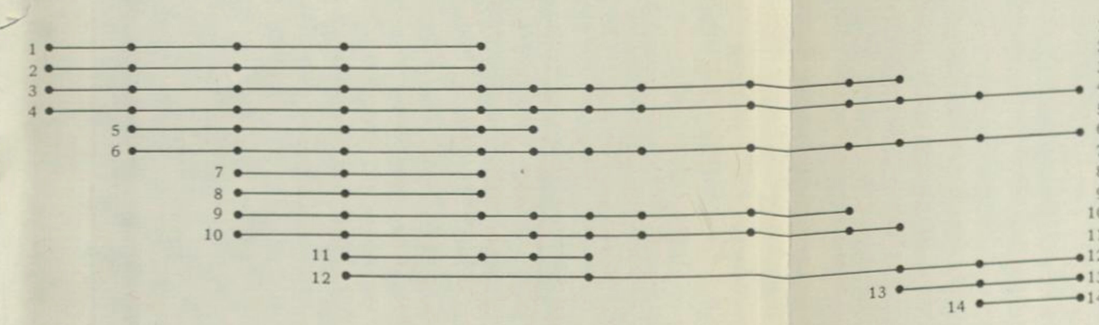




OSTRACODA

1 *Echinocythereis jacksonensis*
2 *"Cythereis" hysonensis*
3 *Jugosocythereis bicarinata*
4 *Actinocythereis* n. sp. 2
5 N. Gen. n. sp. 1
6 *Bairdoppilata ocalana*
7 *Cushmanidea* n. sp. 1
8 *Loxoconcha creolensis*
9 *Clithrocytheridea caldwellensis*
10 *C. garretti*
11 *C. grigsbyi*
12 *Cyamocytheridea watervalleyensis*
13 *Digmocytheridea watervalleyensis*
14 *Cytheretta jacksonensis*
15 *Actinocythereis gibsonensis*
16 *Occultocythereis broussardi*
17 *Haplocytheridea montgomeryensis*
18 *"Cythereis" dohmi*
19 *Isocythereis couleycreekensis*
20 *Henryhowella florienensis*
21 *Digmocythere russelli*
22 *Bairdia* sp. 1
23 *Actinocythereis* n. sp. 1
24 *Actinocythereis* n. sp. 4
25 *Echinocythereis mcguirti*
26 *Bythocypris gibsonensis*
27 *Pterygocythereis ivani*
28 *Pterygocythereis murrayi*
29 *Trachyleberis montgomeryensis*
30 *Actinocythereis dacyi*
31 *Trachyleberidea blanpiedi*
32 *Krithe hiwanneensis*
33 *Paracypris rosefieldensis*
34 *Cytherella* sp. 1
35 *Propontocypris mississippiensis*
36 *Paracytheridea woodwardensis*
37 *Argilloecia hiwanneensis*
38 *Jugosocythereis vicksburgensis*
39 *Ambocythere* n. sp. 1



PLANKTONIC FORAMINIFERA

1 *Pseudohastigerina micra*
2 *Hantkenina alabamensis*
3 *Globigerina pseudoampliapertura*
4 *G. yeguaensis yeguaensis*
5 *Globorotalia cerroazulensis*
6 *Globigerina tripartita tripartita*
7 *Cribrohantkenina inflata*
8 *Hastigerina danvillensis*
9 *Globigerina yeguaensis pseudovenezuelana*
10 *G. ouachitaensis*
11 *Globorotalia centralis*
12 *G. increbescens*
13 *Globigerina ampliapertura*
14 *Globigerinita dissimilis*

Range chart of ostracods and planktonic foraminifers from Little Stave Creek.

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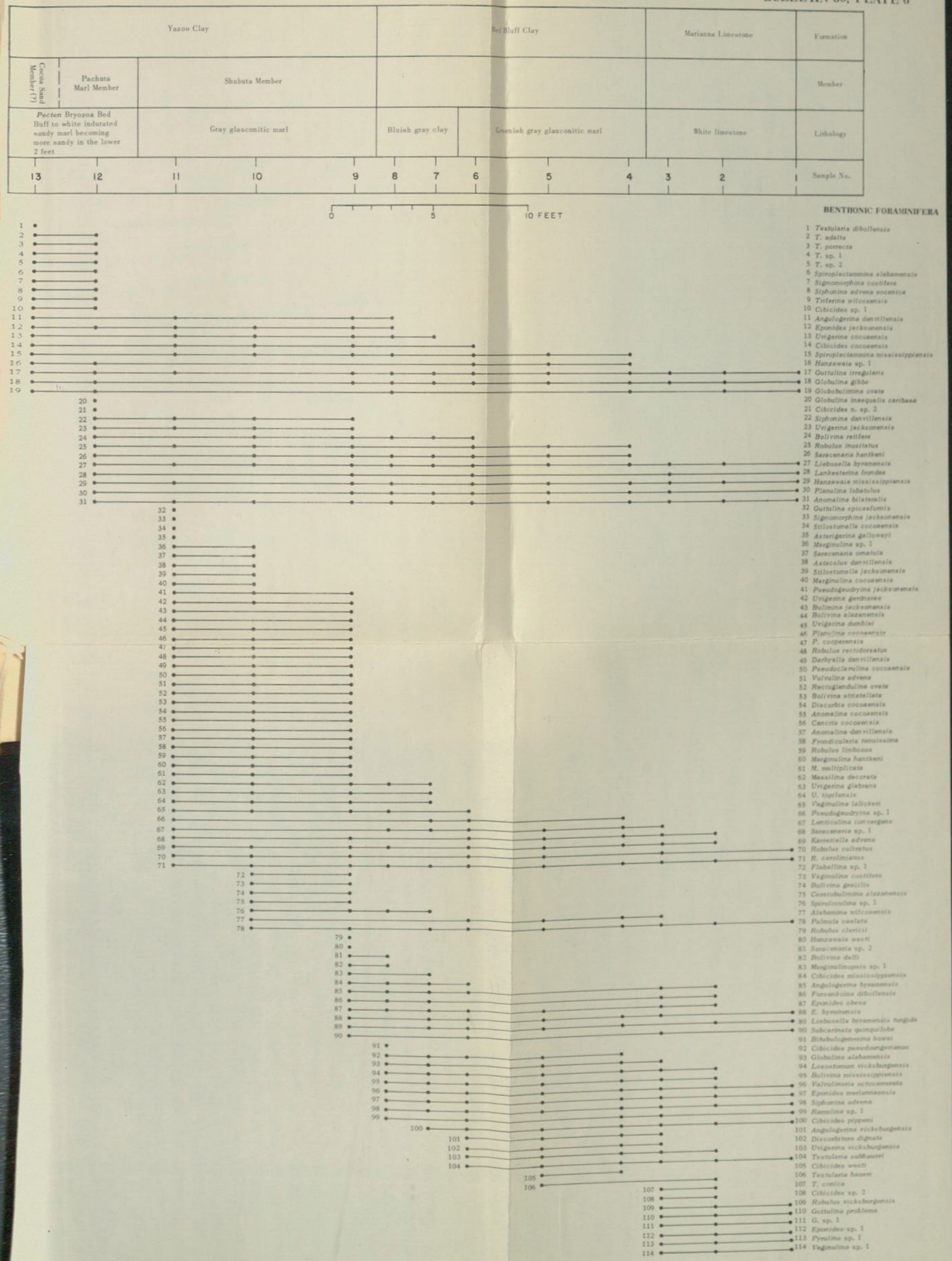

Range chart of benthonic foraminifers from Little Stave Creek.